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THE

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

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STYLOPS.

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LIST OF FELLOWS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON.

HONORARY FELLOWS.

Date of Election.

1905 Bolivar, Ignacio, *Museo nacional de Historia natural, Hipodromo*, 17, *Madrid, Spain.*

1925 Gestro, Prof. R., *Direttore del Museo Civico di Storia Naturale, Genova, Italy.*

1931 (1929) Horn, Dr. Walther, 20, *Gosslerstrasse, Berlin-Dahlem, Germany.*

1926 Horvath, Dr. Geza, *Museum Nationale Hungaricum, Budapest, Hungary.*

1915 ‡ Howard, Dr. L. O., *Ex-Chief, Bureau of Entomology, U.S. Dept. of Agriculture, Washington, U.S.A*

1914 Lameere, Professor A., 74, *rue Defarq, Bruxelles, Belgium.*

1918 Marchal, Dr. Paul, 45, *rue de Verrières, Antony, Seine, France.*

1931 (1877) Oberthür, M. Réné, *Rennes, Ille-et-Vilaine, France.*

1931 Rebel, Prof. H., *Naturhistorisches Museum, Burgring* 7, *Vienna I, Austria.*

1913 Semenoff Tian-Shanski, A. P., *Vassili Ostrov*, 8 *lin.*, 39, *Leningrad, U.S.S.R.*

1931 ‡ Silvestri, Prof. F., *R. Istituto Superiore Agraria, Portici, Naples, Italy.*

1931 Wheeler, Prof. W. M., Ph.D., Sc.D., LL.D., *Museum of Comparative Zoology, Harvard College, Cambridge, Mass., U.S.A.*

SPECIAL LIFE FELLOWS.

Date of Election.

1926 (1891) Frohawk, F. W., *Essendene, Cavendish-road, Sutton, Surrey.*

1923 (1889) Johnson, The Rev. W. F., M.A., *Roxboro' Terrace, Rostrevor, Co. Down, Ireland.*

*1929 (1920) ‡ Meldola, Mrs. E. F., 6, *Brunswick-square*, W.C. 1.

1926 (1890) Newstead, Prof. R., M.Sc., F.R.S., A.L.S., Hon. F.R.H.S., *St. Mary's Cottage*, 67, *Handbridge, Chester.*

1932 (1895) Nurse, Lt.-Col. C. G., *Redcote, Rusthall Park, Tunbridge Wells.*

1931 (1905) Powell, H., *Pharmacie du Croissant, Meknès-Medina, Morocco.*

FELLOWS.

(*The names of those who have not yet paid either the Entrance Fee or the first year's subscription are not included.*)

Marked * *died during the year* 1932.
Marked † *have compounded for their Annual Subscriptions.*
Marked ‡ *have been formally admitted into the Society* (*to Dec.* 1932).

Date of Election.

1913 ‡ Adams, B. G., *The Old Rectory, Swell, Fivehead, Somerset.*
1902 ‡ Adkin, B. W., "*Highfield,*" *Penbury, Tunbridge Wells.*
1885 ‡ Adkin, Robert (V.-Pres., 1922, 1928; Council, 1901–2, 1911–13, 1921–3, 1927–9), *Hodeslea, Meads, Eastbourne.*
1921 Alexander, Prof. C. P., *Fernald Hall, Massachusetts Agricultural College, Amherst, Mass., U.S.A.*
1931 Alfieri, Anastase, *P.O. Box* 430, *Cairo, Egypt.*
1920 ‡ Altson, A. M., 41, *The Residency, von Brandis'-square, Johannesburg, S. Africa.*
1919†‡Andrewes, Dr. C. H., 32, *Ossulton-way*, N. 2.
1910†‡Andrewes, H. E. (Council, 1920–2), 8, *North-grove, Highgate*, N. 6.
1922 ‡ Andrewes, H. L., *The Warren, Bere Regis, Wareham, Dorset.*
1932 ‡ Andrews, E. A., *Broomhills, Billericay, Essex.*
1899 ‡ Andrews, Henry W. (Council, 1930–), 6, *Footscray-road, Eltham*, S.E. 9.
1901 ‡ Anning, William, 15, *Arthur-street West*, E.C. 4.
1908 † Antram, Charles B., *Heathfield, Moorland-road, West Moors, Dorset.*
1930 Armstrong, K. F., *John Winthrop House, Harvard University, Cambridge, Mass., U.S.A.*
1927 ‡ Armstrong, R. R., B.A., M.D., B.Ch., 65, *Lee-road, Blackheath*, S.E. 3.
1913 ‡ Armytage, Edward O., *c/o The Westminster Bank, Ltd.*, 25, *Sussex-place*, S.W. 7.
1907 ‡ Arnold, G., D.Sc., A.R.C.S., Box 240, *Bulawayo, South Africa.*
1899†‡Arrow, G. J. (Council, 1905–7), 9, *Rossdale-road, Putney*, S.W. 15; and *British Museum* (*Natural History*), *Cromwell-road*, S.W. 7.
1911 ‡ Ashby, E. B., 36, *Bulstrode-road, Hounslow, Middlesex.*
1907†‡Ashby, Sidney R., 37, *Hide-road, Headstone, Harrow.*
1925 Ashworth, J. H., *Walton Fold, Longridge, Preston, Lancs.*
1921 Atkinson, D. J., *Ataran Forest Division, Moulmein, Burma.*
1927 ‡ Attia, R., A.R.C.S., B.Sc., *Plant Protection Section, Ministry of Agriculture, Cairo, Egypt.*
1928 ‡ Aubertin, Miss D., *British Museum* (*Natural History*), *Cromwell-road*, S.W. 7.
1930 Austin, M. D., *Dept. Economic Entomology, South-Eastern Agricultural College, Wye, Kent.*
1913 Avinoff, A., Director, *Carnegie Museum, Pittsburg, U.S.A.*

1904†‡Bagnall, Richard S., D.Sc., F.R.S.E., F.L.S., 9, *York-place, Edinburgh.*
1909 ‡ Bagwell-Purefoy, Capt. Edward, F.Z.S. (Council, 1930–), *The Cottage, East Farleigh, Maidstone.*
1903–1913, 1924 :
‡ Baldock, G. R., *Oakburn Villa,* 467, *Hertford-road, Enfield Highway.*
1916 ‡ Balfour, Miss Alice, *Whittingehame, Haddington, Scotland.*
1921 ‡ Balfour-Browne, Prof. W. A. F., F.R.S.E., F.L.S., F.Z.S. (Council, 1925-7), *Winscombe Court, Winscombe, Somerset.*
1912 ‡ Ballard, E., *Department of Agriculture, Jerusalem.*
1890 Barclay, Francis H., F.G.S., *The Warren, Cromer.*
1902 ‡ Barraud, P. J., *Central Research Institute, Kasauli, Punjab, India.*
1932 ‡ Bartlett, C., *Morwenstow,* 8, *Woodhill, Portishead, nr. Bristol.*
1907 ‡ Bartlett, H. Frederick D., *Island of St. Helena, S. Atlantic.*
1908 Bayford, E. G., 2, *Rockingham-street, Barnsley.*
1912 ‡ Baynes, E. S. A., *Monkshatch Cottage, Compton, Guildford, Surrey.*
1896†‡Beare, Prof. Sir T. Hudson, B.Sc., F.R.S.E. (V.-Pres., 1910, 1932; Council, 1909–11, 1925–7, 1932–), 10, *Regent-terrace, Edinburgh.*
1912 Bedford, Gerald, *Division of Veterinary Services, P.O., Ondestepoort, Pretoria, S. Africa.*
1913 Bedford, Capt. H. W., *W.T.R. Laboratories, Khartoum, Sudan.*
1899 ‡ Bedwell, Ernest C. (V.-Pres., 1922; Council, 1917–19, 1922–4, 1929–31), *Bruggen, Brighton-road, Coulsdon, Surrey.*
1920 ‡ Beeson, C. F. C., *Indian Forest Service, Forest Research Institute, Dehra Dun, U.P., India.*
1927 ‡ Bell, J. H., *Dudswell-rise, Northchurch, Berkhamsted.*
1904 Bengtsson, Simon, Ph.D., *Universitetsbibliothek, Lund, Sweden ;* Curator, Entomological Collection of the University.
1915 Benham, Prof. W. B., M.A., D.Sc., F.R.S., *University of Otago, Dunedin, New Zealand.*
1925 ‡ Benson, R. B., M.A., *British Museum (Nat. Hist.), Cromwell-road.,* S.W. 7.
1913 ‡ Best-Gardner, Charles C.
1885 ‡ Bethune-Baker, George T., F.L.S., F.Z.S. (Pres., 1913–14; V.-Pres., 1910–11, 1915; Council, 1895, 1910–12, 1915, 1919–21), 9, *Eversfield-road, Eastbourne.*
1891 ‡ Blaber, W. H., F.L.S., 34, *Cromwell-road, Hove, Sussex.*
1904 ‡ Blair, Kenneth G., B.Sc. (Council, 1918–20, 1932–), *Claremont,* 120, *Sunningfields-road, Hendon,* N.W. 4.
1904 ‡ Bliss, M. F., M.C., M.R.C.S., L.R.C.P., *Branston, nr. Rugby.*
1903 Bogue, W. A., 34, *Handen-road, Lee,* S.E. 12.
1929 Bolivar y Pieltain, Prof. C., *Museo Nacional de Ciencias Naturales, Madrid.*
1921 ‡ Bolton-King, E., *Christ Church, Oxford.*
1902 ‡ Bostock, E. D., *Oulton Cross, Stone, Staffs.*
1921 Bouck, Baron J., *Springfield, South Godstone, Surrey.*
1894 † Bowles, E. Augustus, M.A., *Myddelton House, Waltham Cross.*
*1912 † Bowring, C. Talbot, *St. Francis, Benfield-way, Portslade, nr. Hove, Sussex.*
1921 ‡ Box, H. E., *Antigua Sugar Factory, St. John's, Antigua, B.W.I.*
1910 Boyd, A. Whitworth, *Frandley House, nr. Northwich, Cheshire.*

1920 Boyd, Lt.-Col. J. E. M., M.C., *The British Military Hospital, Ahmednagar, Deccan, India.*
1905 Bracken, Charles W., B.A., 16, *De la Hay Villas, Plymouth.*
1919 ‡ Bradley, Prof. J. Chester, M.Sc., Professor of Entomology and Curator of Invertebrate Zoology, *Cornell University, Ithaca, New York, U.S.A.*
1920 ‡ Brenchley, Dr. Winifred E., D.Sc., F.L.S., *Rothamsted Experimental Station, Harpenden, Herts.*
1930 Breyer, Adolfo (Jun.), *Florida* 414, *Buenos Aires, Argentina.*
1930 Breyer, Alberto, *Florida* 414, *Buenos Aires, Argentina.*
1894 ‡ Bright, P. M., "*Nethercourt,*" 60, *Christchurch-road, Bournemouth.*
1924 ‡ Brindley, Mrs. M. D., 25, *Madingley-road, Cambridge.*
1909 ‡ Britten, Harry, 22, *Birch-grove, Levenshulme, Manchester.*
1925 ‡ Brooks, C. J., 11, *Carlton Mansions, West End-lane,* N.W. 6.
1932 Brown, F. Martin, *Fountain Valley, Colorado Springs, Colo., U.S.A.*
1919 Brown, J. M., B.Sc., F.L.S., 176, *Carterknowle-road, Millhouses, Sheffield.*
1910 Browne, H. B., M.A., *Kenilworth, Scatcherd-lane, Morley, Yorks.*
1909 Bryant, Gilbert E., 82, *Rivermead Court, Hurlingham,* S.W.
1919 ‡ Buckhurst, A. S., *Pathological Laboratory, Milton-road, Harpenden, Herts.*
1930 Bucknill, The Rev. E. G., M.A., 234, *The Bluff, Yokohama, Japan.*
1907 Bulleid, Arthur, F.S.A., *Dimboro, Midsomer Norton, Somerset.*
1929 Burdett, E. F., 180, *High-street, Lowestoft, Suffolk.*
1922 Burns, A. N., Sugar Experiment Station, *Mackay, N. Queensland, Australia.*
1896†‡Burr, Malcolm, D.Sc., F.G.S., A.R.S.M. (V.-Pres., 1912; Council, 1903–4, 1910–12), *United University Club, Pall Mall East,* S.W. 1; *Trans. to :— Moscow, Petrovskaia Agricultural Academy, Prof. V. F. Boldyrev.*
1920 Burras, A. E., 3, *Connaught-road, North End, Portsmouth.*
1909 ‡ Burrows, The Rev. C. R. N., *The Vicarage, Mucking, Stanford-le-Hope, Essex.*
1932 Burtt, B. D., *Tsetse Research Dept., Old Shinyanga, Tanganyika Territory.*
1922 ‡ Bushby, L. C., 11, *Park-grove, Bromley, Kent.*
1920 ‡ Bushell, Capt. H. S., *Ravensholt, Harrow-on-the-Hill.*
1922 Butler, A. E., *c/o Westminster Bank, Ltd., Clevedon, Somerset.*
1914 † Butterfield, R., Curator, *Corporation Museum, Keighley, Yorks.*
1912†‡ Buxton, P. A., M.A. (Council, 1926–28), *Grit Howe, Gerrard's Cross, Bucks.*

1932 ‡ Cameron, E., B.Sc., *Farnham House Laboratory, Farnham Royal, Bucks.*
1902 ‡ Cameron, Malcolm, M.B., R.N. (Council, 1919–20), 15, *Teesdale-road, Leytonstone,* E. 11.
1913 ‡ Cameron, W. P. L., *Gezira Research Farm, Wad Medani, Blue Nile Province, Sudan.*
1923 ‡ Campbell-Taylor, J. E., *Barclay's Bank House, Pembroke Dock, S. Wales.*
1910 Carlier, E. Wace, M.D., F.R.S.E., *Morningside, Granville-road, Dorridge, Warwickshire,* and *The University, Birmingham.*
1924 ‡ Carlier, S. E. Wace, *Morningside, Granville-road, Dorridge, Warwickshire.*
1910†‡Carpenter, G. D. Hale, M.B.E., D.M., *Penguelle, Hid's Copse-road, Cumnor Hill, Oxford.*
1895 ‡ Carpenter, George H., D.Sc., M.R.I.A. (Council, 1932), *The Manchester Museum, The University of Manchester.*

1915 Carr, Prof. J. W., M.A., F.L.S., F.G.S., Hon. F.R.H.S., Emeritus Professor of Biology in University College, *Mapperley Edge, Private-road, Sherwood, Nottingham.*

1912 Carter, H. F., *The Office of Medical Entomologist, Torrington-square, Colombo, Ceylon.*

1906 ‡ Carter, H. J., B.A., *Garrawillah, Kintore-street, Wahroonga, Sydney, N.S.W.*

1921 Castle, Miss Amy, *Dominion Museum, Wellington, New Zealand.*

1921 ‡ Cator, Douglas, 13, *Westminster-mansions, Gt. Smith-street,* S.W. 1.

1889†‡Cave, Charles J. P.

1920 ‡ le Cerf, F., Curator of Lepidoptera in the Paris Museum, 13, *rue Guy de la Brosse, Paris, Ve.*

1914 ‡ Champion, H. G., M.A., *Forest Research Institute, Dehra Dun, U.P., India.*

1919 Chatterjee, N. C., B.Sc., *Forest Research Institute, Dehra Dun, U.P., India.*

1923 Chatterjee, S. N., *Forest Research Institute, Dehra Dun, U.P., India.*

1897 ‡ Chawner, Miss Ethel F., *The White House, Leckford, Stockbridge, Hants.*

1913 ‡ Cheavin, W. H. S., F.C.S., F.R.M.S., 19, *Rosendale-road, W. Dulwich,* S.E. 21.

1919 Cheesman, Miss L. Evelyn, 63, *Longridge-road,* S.W. 5.

1920 ‡ Cheetham, C. A., *Austwick, via Lancaster.*

1889 Christy, William M., M.A., F.L.S., *Watergate, Emsworth.*

1909 Clark, Lt.-Col. C. Turner, F.Z.S., *The Hutch, Shirley Warren, Southampton.*

1923 Clarke, C. E.

1929 Clarkson, Miss Lucy I., *Apipucos, Recife (Pernambuco), Brazil.*

1914 ‡ Cleare, L. D., Jr., *Dept. of Agriculture, Georgetown, British Guiana.*

1922 Clutten, Wm. George, 136, *Coal Clough-lane, Burnley.*

1908 Clutterbuck, C. Granville, 23, *Heathville-road, Gloucester.*

1904 ‡ Cockayne, E. A., M.A., M.D., F.R.C.P. (V.-Pres., 1927, Council, 1915–17, 1926–28), 116, *Westbourne-terrace,* W. 2.

1920 Cockcroft, T., 111, *Owen-street, Wellington South, New Zealand.*

1917 ‡ Cockerell, Prof. T. D. A., *University of Colorado, Boulder, Colorado, U.S.A.*

1914 Coleman, Leslie C., *Dept. of Agriculture, Bangalore, Mysore, India.*

1922 ‡ Collenette, C. L., *Ashburton Hotel, The Terrace, Richmond, Surrey.*

1899 ‡ Collin, James E. (President, 1927–8; V.-Pres., 1913, 1923, 1929; Council, 1904–06, 1913–15, 1923–25, 1929), *Raylands, Newmarket.*

1918 Comstock, Dr. J. A., *c/o Los Angeles Museum, Exposition Park, Los Angeles, California, U.S.A.*

1924 ‡ Cooke, Brig.-Gen. B. H., C.M.G., C.B.E., D.S.O., *Inniscrone, Datchet, Bucks.*

1926 Cooper, Mrs. J. Omer, B.A., 23, *Leazes-terrace, Newcastle-on-Tyne.*

1921 Coote, F. D., 71, *Fenchurch-street,* E.C. 3.

1924 Corbett, G. H., B.Sc., Government Entomologist, S.S., and F.M.S., *Kuala Lumpur, F.M.S.*

1916 Cornford, The Rev. Bruce, 43, *Havelock-road, Portsmouth.*

1921 ‡ Corporaal, J. B., *Zoological Museum, Plantage Middenlaan* 53, *Amsterdam, C.*

1924 ‡ Cott, Hugh B., M.A., F.R.P.S., F.Z.S., *The Elms, Elmlea-avenue, Stoke Bishop, Bristol.*

1923 Cottam, R., *c/o Wm. Taylor,* 62, *Victoria-street, Chadderton, Oldham.*

1920 ‡ Cotterell, G. S., A.R.C.S., Box 23, *Dept. of Agriculture, Aburi, Gold Coast, B.W.A.*
1928 Covell, Major G., I.M.S., M.D., *Malaria Survey of India, Kasauli, Punjab, India.*
1913 Coward, T. A., F.Z.S., 36, *George-street, Manchester.*
1931 Cowland, J. W., *Wellcome Tropical Research Laboratories, Khartoum, Sudan.*
1931 Cowley, John, B.A., 59, *Hills-road, Cambridge.*
1931 Cox, Bevan C., *The Fishery, Mapledurham, Oxon.*
1923 ‡ Cox, L. G., 9, *Chichester-terrace, Brighton.*
1920 ‡ Crabbe, E., 52, *Sarsfield-road, Balham,* S.W. 12.
1895 Crabtree, B. H., *Holly Bank, Alderley Edge, Cheshire.*
1919 Crampton, Prof. G. Chester, *Massachusetts Agricultural College, Amherst, Mass., U.S.A.*
1922 ‡ Crawford, Wm. Monod, B.A., *Orissa, Marlborough-park, Belfast.*
1928 ‡ Crewdson, R. C. R., *The Grange, Delamere, Northwich, Cheshire.*
1919 ‡ Cumming, B. D., *Whistman's Wood, West Clandon, Surrey.*
1927 Cunliffe, N., M.A., D.Sc., *The School of Rural Economy, University of Oxford.*
1908 ‡ Curtis, W. P., *Richmond Chambers, Bournemouth.*

1930 Daintree, A. C., *P.O. Box* 797, *Lourenço Marques, Portuguese East Africa.*
1929 ‡ Daltry, H. W., *Bar Hill, Madeley, nr. Crewe.*
1928 Dampf, Dr. A., Chief Government Entomologist, *Avenida Insurgentes,* 171, *Mexico, D.F., Mexico.*
1930 Davies, W. Maldwyn, Ph.D., B.Sc., *University College of N. Wales, Memorial Buildings, Bangor.*
1913 ‡ Davidson, James, D.Sc., F.L.S. (Council, 1922–4), *Waite Agricultural Research Institute, Glen Osmond, University of Adelaide, S. Australia.*
1903 Day, F. H., 26, *Currock-terrace, Carlisle.*
1898 Day, G. O., *Sahlatston, Duncan's Station, Vancouver Island, British Columbia.*
1923 Dean, J. Davy, *Heathwaite, Heath Park-avenue, Cardiff.*
1930 Deshpande, V. G., M.Ag., *College of Agriculture, Poona, India.*
1923 Dewar, D. A., M.B., C.M., *Altyre House, Stanley, S.O., Co. Durham.*
1930 ‡ Dibb, J. R., 45, *King George Avenue, Chapel Allerton, Leeds.*
1917 ‡ Dicksee, Arthur, 24, *Lyford-road, Wandsworth Common,* S.W. 18.
1929 ‡ Dinnage, H., *Stable Houses, Lower Beeding, Horsham.*
1887 ‡ Dixey, Frederick Augustus, M.A., M.D., F.R.S., Hon. Fellow of Wadham College (Pres., 1909–10; V.-Pres., 1904–5, 1911; Council, 1895, 1904–6), *Wadham College, Oxford.*
1921 Dobson, H. W., 14, *Finkle-street, Kendal.*
1909 † Dobson, Thomas, 33, *The Park, Sharples, Bolton.*
1912 ‡ Doig, Major K. A. C., R.A.M.C., M.R.C.S., L.R.C.P., *Karundas Estate, P.O. Nyeri, Kenya Colony.*
1891 ‡ Donisthorpe, Horace St. John K., F.Z.S. (V.-Pres., 1911; Council, 1899–1901, 1910–12, 1931–), 52, *Oakhill-road, East Putney,* S.W. 15.
1913 ‡ Dow, Walter James, *Penang, Guildford-road, Gt. Bookham.*
1910 Downes-Shaw, Rev. Archibald,
1924 ‡ Druitt, Alan, *Willow Lodge, Christchurch, Hants.*

1921 du Porte, E. M., *Macdonald College, Quebec, Canada.*
1913 Duffield, C. A. W., *Pickersden, Brook Ashford, Kent.*
1906 ‡ Dukinfield Jones, E., *Box* 1831, *Mountain-street, Glendale, California, U.S.A.*
1924 Dutt, A., B.A., B.Sc., *Asst. Entomologist, Rustam, Dept. of Agriculture, Baghdad (Iraq).*

1910 ‡ Eales-White, Maj. J. C., F.Z.S., 88, *Mount Ararat-road, Richmond, Surrey.*
1912 ‡ Earl, Herbert L., M.A., *Vanessa, Rawlyn-road, Torquay.*
1927 ‡ Earle, E., *Goodrest, Hambrook, Chichester.*
1924 Eastham, L., M.Sc., *Zoological Laboratory, The Museums, Cambridge.*
1890–1914, 1922 :
Eastwood, John E., *Middleham, Ringmer, Lewes, Sussex.*
1902 ‡ Edelsten, H. M. (V.-Pres., 1928; Council, 1926–28), *Bramble Hill, Balcombe, Sussex.*
1927 Edmonds, T. H., *Strathmore, Totnes, Devon.*
1911 ‡ Edwards, F. W., M.A., Sc.D. (Council, 1929–31), 56, *Norton-road, Letchworth.*
1884 ‡ Edwards, Stanley, F.L.S., F.Z.S. (Council, 1912–14), 15, *St. Germans-place, Blackheath,* S.E. 3.
1924 ‡ Edwards, W. H., *Dept. of Agriculture, Kingston, Jamaica.*
1916 ‡ Efflatoun Bey, Prof. H., 20–22, *Rustum Pacha-street, Helouan, Egypt.*
1927 Elliston-Wright, F. R., M.D., *Braunton, N. Devon.*
1900 ‡ Elliott, E. A., 41, *Chapel Park-road, St. Leonards-on-Sea.*
1924 Ellis, E. T., F.R.H.S., *Westwood, Ecclesall, Sheffield.*
1900 ‡ Ellis, H. Willoughby, F.Z.S., V.-Pres. (V.-Pres., 1924, 1931; Council, 1916–18, 1922–24, 1929–31), *Speldhurst Close, Sevenoaks, Kent,* and *Junior Carlton Club, Pall Mall,* S.W. 1.
1919 Elston, Albert H., "*Llandyssill,*" *Aldgate, South Australia.*
1903 ‡ Eltringham, Harry, M.A., D.Sc., F.R.S., F.Z.S., President (Secretary, 1922–25; V.-Pres., 1914, 1918, 1926; Council, 1913–15, 1918–20, 1926–28, 1930), *Woodhouse, Stroud, Gloucestershire.*
1927 ‡ Embry, B., *St. Bartholomew's Vicarage, Dover.*
1927 Esaki, T., *College of Agriculture, Kyushu Imperial University, Fukuoka, Japan.*
1930 Evans, Miss Alwen M., D.Sc., 33, *Greenhill Avenue, Mossley Hill, Liverpool.*
1926 Evans, Col. G. H., C.I.E., C.B.E., *c/o National Bank of India, Ltd.,* 26, *Bishopsgate,* E.C. 2.
1928 ‡ Evans, J. W., *Waite Agricultural Research Institute, Glen Osmond, Adelaide, Australia.*
1919 ‡ Evans, Brigadier, W. H., C.S.I., C.I.E., D.S.O., 42, *Harrington-gardens,* S.W. 7.

1919 ‡ Falconer, William, 25, *Ashdale-road, Waterloo, Liverpool.*
1927 Falkner, H. J., *Gyfu, Barton, Torquay.*
1924 ‡ Farmiloe, H. J. C., *Purley Park, nr. Reading, Berks.*
1925 ‡ Fassnidge, W., 47, *Tennyson-road, Southampton.*
1918 ‡ Ferguson, A., 433, *Kilmarnock-road, Newlands, Glasgow.*

1922 Fernald, H. T., Ph.D., 707, *E. Concord-av., Orlando, Florida, U.S.A.*
1930 Fletcher, P. Bainbrigge, 65, *Compton-road, Wimbledon*, S.W.
1898 ‡ Fletcher, Fleet Paymaster Thomas Bainbrigge, R.N., F.L.S., F.Z.S., *Rodborough Fort, Stroud, Glos.*
1883 † Fletcher, William Holland B., M.A., *Aldwick Manor, Bognor.*
1905 Floersheim, Cecil, 16, *Kensington Court Mansions*, S.W.8.
1922 Flower, Miss A. B., "*Langtrees,*" *Landford, nr. Salisbury.*
1928 ‡ Forbes, Comm. Wyndham, D.S.O., R.N., *Naval and Military Club*, 94, *Piccadilly*, W.1.
1924 ‡ Ford, E. B., M.A., B.Sc., *Dept. of Zoology and Comparative Anatomy, University Museum, Oxford.*
1932 Ford, W. K., *Citrus Experimental Station, Mazoe, S. Rhodesia.*
1913 Foster, Arthur H., M.R.C.S., L.R.C.P.(Eng.), M.B.O.U., 13, *Tilehouse-street, Hitchin, Herts.*
1898 ‡ Fountaine, Miss Margaret E.,
1920 ‡ Fox-Wilson, G., *Entomological Dept., R.H.S. Laboratory, Wisley, Ripley, Surrey.*
1928 Francis, H. O., 1, *Gatcombe-road, Tufnell Park*, N. 19.
1908 Fraser, F. C., Lt.-Col., M.D., I.M.S., *c/o Bombay Natural History Society, 6, Apollo-street, Bombay, India.*
1888 ‡ Fremlin, H. Stuart, M.R.C.S., L.R.C.P., *Heaver's, Thyarsh, nr. West Malling, Kent.*
1910 ‡ Frisby, G. E., 29, *Darnley-road, Gravesend.*
1907 ‡ Fryer, J. C. F., O.B.E., M.A. (V.-Pres., 1927, Council, 1916–18, 1925–27), *Milton-road, Harpenden, Herts.*

1930 ‡ Gabriel, A. G., *Wilfadene, Kings End, Ruislip, Middx.*
1887 ‡ Gahan, Charles Joseph, M.A., D.Sc. (Pres., 1917–18; V.-Pres., 1916, 1919; Sec., 1899–1900; Council, 1893–95, 1901, 1914–16, 1919), *The Mount, Aylsham, Norfolk.*
1920 Gardner, J. C. M., *Forest Research Institute, Dehra Dun, U.P., India.*
1901 †‡ Gardner, Willoughby, D.Sc., F.L.S., F.S.A., *Y Berlfa, Deganwy, N. Wales.*
1923 Garrett, F. C., O.B.E., D.Sc., *South View House, Alnmouth, Northumberland.*
1931 ‡ Garthside, Stanley, *Farnham House Laboratory, Farnham Royal, Bucks.*
1922 ‡ Gater, B. A. R., M.A., D.I.C., F.R.M.S., Professor of Biology, *King Edward VII College of Medicine, Singapore, Straits Settlements.*
1920 Gauntlett, Dr. H. Leon, A.K.C., F.Z.S., 37, *Howard's-lane, Putney*, S.W. 15.
1919 ‡ Gedye, A. F. J., *P.O. Box* 216, *Nairobi, Kenya Colony.*
1923 Gee, G. F., *Abbotsford, Cuddington, nr. Northwich, Cheshire.*
1922 ‡ Ghosh, C. C., B.A., *Agricultural College, Mandalay, Burma, India.*
1930 Gibbins, E. G., *Box* 41, *Kampala, Uganda.*
1915 ‡ Gibson, Arthur, *Dominion Entomologist, Dept. of Agriculture, Ottawa, Canada.*
1925 Gilles, W. S., F.I.C., F.C.S., *The Cottage, Bocking, Braintree, Essex.*
1904 ‡ Gilliat, Francis T., B.A., 25, *Manor-road, Folkestone.*
1919 ‡ Gimingham, C. T., O.B.E., F.I.C., *Ministry of Agriculture, Pathological Laboratory, Milton-road, Harpenden, Herts.*
1930 ‡ Glegg, D. Lindsay, *Birchstone Coombe Park, Kingston, Surrey.*
1914 ‡ Godfrey, E. J., 1902, *Hicks'-lane, Bangkok, Siam.*

1924 Golding, F. D., *Moor Plantation, Ibadan, S. Provinces, Nigeria.*
1920 ‡ Goodban, B. S., *Watersmeet, West-street, Ewell, Epsom, Surrey.*
1927 ‡ Goodman, A. de B., *Normanby, Potters Bar, Middx.*
1904 Goodwin, Edward, *Canon Court, Wateringbury, Kent.*
1925 ‡ Gordon, D. J., B.A., *The Manor House, Strathpeffer, N.B.*
1898 ‡ Gordon, J. G. McH., *Corsemalzie, Whauphill S.O., Wigtownshire.*
1929 Graham-Smith, G. S., M.D., F.R.S., *Dept. of Pathology, Tennis Court-road, Cambridge.*
1927 Grandi, Prof. Dr. Guido, *R. Instituto Superiore Agrario, Bologna, Italy.*
1924 Grant, J. H., *Cole Dale View, Coleshill-road, Ward End, Birmingham.*
1931 ‡ Grant, Mrs. Katherine J., *Lithend, Luton-road, Wheathampstead, Herts.*
1911 ‡ Graves, P. P., 5, *Hereford-square,* S.W. 7.
1891†‡Green, E. Ernest, F.Z.S. (Pres., 1923–24; V.-Pres., 1915, 1925; Council, 1914–16, 1925), *Way's End, Beech-avenue, Camberley.*
1932 ‡ Green, T. L., B.Sc., 4, *Albert Bridge-road, S.W.*11.
1893 † Greenwood, H. P., F.L.S., *Whitsbury House, Salisbury.*
1921 Greenwood, W. F. N., *C.S.R. Co., Lautoka, Fiji.*
1932 ‡ Gregson, Col. G. K., D.S.O., *Cob Orchard, Plaxtol, Kent.*
1928 ‡ Grensted, The Rev. Prof. L. W., M.A., D.D., *Oriel College, Oxford.*
1894 ‡ Grimshaw, Percy H., *Royal Scottish Museum, Edinburgh.*
1905 Grist, Charles J., *The Croft, Carol Green, Berkswell, Coventry.*
1920 ‡ Grosvenor, T. H. L., *Springvale, Linkfield-lane, Redhill, Surrey.*
1927 Gunder, J. D., 310, *Linda Vista Avenue, Pasadena, California, U.S.A.*
1920 ‡ Gunton, Major H. C., *Rathgar, Milton-av., Gerrard's Cross, Bucks.*
1906 Gurney, Gerard H., *Keswick Hall, Norwich.*
1910 Gurney, William B., Govt. Entomologist, *Department of Agriculture, Sydney, Australia.*

1912 Hacker, Henry, *Queensland Museum, Brisbane, Queensland.*
1919 Hadwen, Dr. Seymour, D.Vet.Sci., 579, *Huron-street, Toronto, Canada.*
1925 ‡ Haig-Thomas, P., *The Grange, Goring-on-Thames.*
1906 ‡ Hall, Arthur, 29*a*, *Dingwall-road, Croydon, Surrey.*
1885 ‡ Hall, T. W., *Wood Grange, Shire-lane, Chorley Wood, Herts.*
1921 ‡ Hall, W. J., D.Sc., Director, *The B.S.A. Co.'s Citrus Experimental Station, Mazoe, S. Rhodesia.*
1912 ‡ Hallett, H. M., 64, *Westbourne-road, Penarth, Glamorganshire.*
1923 ‡ Halliwell, A. C., F.R.C.S., 1, *Cæsarea-place, Jersey, C.I.*
1929 Hamlin, W. E., 3, *St. Mark's-place, Wimbledon,* S.W. 19.
1915 ‡ Hamm, Albert Harry, A.L.S., 22, *Southfield-road, Oxford.*
1928 ‡ Hammond, C. O., 56, *Boreham-road, Lordship-lane, Wood Green,* N. 22.
1891 ‡ Hanbury, Frederick J., F.L.S., *Brockhurst, E. Grinstead.*
1923 ‡ Hancock, G. L. R., *Dept. of Agriculture, Box* 5, *Kampala, Uganda; Trans. to :—c/o Archdeacon Hancock, The Rectory, Whatley, Frome, Soms.*
1923 Handley, G., 54, *All Saints'-road, Kings Heath, Birmingham.*
1932 Hanna, A. D., *Imperial College of Science, Biological Field Station, Slough, Bucks.*
1929 ‡ Hanson, H. S., *Farnham House Laboratory, Farnham Royal, Bucks.*
1930 Hardwicke, S. M. B., *Friarmayne, Nr. Dorchester.*

1903 ‡ Hare, E. J., 4, *New-square, Lincoln's Inn*, W.C. 2.
1920 ‡ Hargreaves, E., *Lands and Forest Dept., Freetown, Sierra Leone.*
1920 Hargreaves, H., *Govt. Entomologist, Dept. of Agriculture, Kampala, Uganda.*
1926 Harmsworth, Sir H. A. B.
1926 Harris, R. H. T. P., Director, *Tsetse Fly Control Operations, P.O. Box* 41, *Empangeni, Zululand, S. Africa.*
1928 Harris, W. V., Asst. Entomologist, *Dept. of Agriculture, Morogoro, Tanganyika Territory.*
1925 Harukawa, C., *Ohara Institute, Kurashiki, Okayama-Ken, Japan.*
1910 ‡ Harwood, Philip, *c/o Westminster Bank, Ltd.*, 92, *Wimborne-road, Winton, Bournemouth.*
1926 Hatch, Melville H., *Dept. of Zoology, University of Washington, Seattle, Washington, U.S.A.*
1919 ‡ Hawker-Smith, W., *Malthouse Farm, Hambledon, Godalming, Surrey.*
1927 ‡ Hawkins, C. N., 23, *Dalebury-road, Upper Tooting*, S.W. 17.
1913†‡Hawkshaw, Oliver, *Holly Combe, Liphook, Hants.*
1924 Hayward, A. R., *Misterton, Somerset.*
1919 ‡ Hayward, H. C., M.A., *Repton, Derby.*
1921 ‡ Hayward, Capt. K. J., F.R.G.S., *c/o Breyer Hmnos, Florida* 414, *Buenos Aires, Argentine.*
1929 Hebbert, G. K. P., *Lee Copse, Berrynarbor, N. Devon.*
1910 ‡ Hedges, Alfred V., *Milton House, Milton Ernest, Beds.*
1919 ‡ Hemming, Francis, C.B.E., F.Z.S., Treasurer (1929– ; Council, 1928), 18, *Glebe-place, Chelsea*, S.W. 3.
1910 Henderson, J., *Ashford House, Talybont-on-Usk, Breconshire.*
1918 Herrod-Hempsall, J., *Sternthorpe, Stockingstone-road, Old Bedford-road, Luton, Beds.*
1903 Herrod-Hempsall, W., *W.B.C., Apiary, Old Bedford-road, Luton, Beds.*
1929 ‡ Heslop, Ian R. P., B.A., 34, *Henleaze Gardens, Westbury-on-Trym, Bristol.*
1925 Hesse, Dr. A. T., *South African Museum, Cape Town, S. Africa.*
1913 Hewitt, John, B.A., Director, *Albany Museum, Grahamstown, S. Africa.*
1923 ‡ Hicks, J. B., 30, *Stanhope Gardens*, S.W. 7.
1922 ‡ Higgins, L. G., M.A., F.R.C.S., *Linkwood, Woking, Surrey.*
1930 ‡ Hincks, W. D., 46, *Gipton Wood-avenue, Harehills, Leeds.*
1924 ‡ Hingston, Major R. W. G., M.C. (Council, 1932–), 17, *Bolton-road, Grove Park, Chiswick*, W. 4.
1929 ‡ Hobby, B. M., B.A., 21, *Methuen-street, Southampton.*
1912 Hodge, Harold, 99, *Highbury-place*, N. 5.
1922 Hogarth, A. Moore, 143, *Golders Green-road*, N.W. 11.
1910 Holford, H. O., *Elstead Lodge, Godalming, Surrey.*
*1887 Holland, The Rev. W. J., D.D., Ph.D., Director Emeritus, *Carnegie Museum, Pittsburgh, Penn., U.S.A.*
1898 ‡ Holman-Hunt, C. B., *The Laurels, Walditch, Nr. Bridport, Dorset.*
1922 ‡ Hopkins, G. H. E., *Box* 41, *Kampala, Uganda.*
1921 Hopper, L. B.
1919 de Horrack-Fournier, Mme., 90, *Boulevard Malesherbes, Paris*, and *Château de Voisins, Louveciennes, Seine-et-Oise, France.*
1928 Hosny, M., Entomological Secretary, *Ministry of Agriculture, Cairo, Egypt.*

1927 ‡ Hucklesby, F. G., *c/o Mrs. Allman, Oak Tree Cottage, Forest Green, Ockley, Surrey.*
1888 Hudson, G. V., *Hill View, Karori, Wellington, New Zealand.*
1907 Hughes, C. N., 78, *Harley House*, N.W. 1.
1921 Hunt, The Rev. J. Wesley, *Wesleyan Methodist Church of S. Africa, Private Bag, P.O. Imvani, C.P., S. Africa.*
1917 Hunter, David, M.A., M.B., *The Coppice, Nottingham.*
1922 ‡ Hutchinson, G. E., *Osborn Zoological Laboratory, Yale University, New Haven, Conn., U.S.A.*
1923 Hutchinson, J. H., M.A., *Holly House, Littlebourne, nr. Canterbury.*

1912†‡Imms, A. D., Sc.D., M.A., F.R.S., F.L.S. (V.-Pres., 1920, 1930; Council, 1919–21, 1930–), *Zoological Laboratory, The Museums, Cambridge.*
1920 Inglis, C. M., F.Z.S., M.B.O.U., *The Museum House, Darjeeling, Bengal, India.*
1932 Irving, G. D., 7, *Maplesbury-road*, N.W. 2.
1931 Issiki, Prof. Syûti T., *School of Agriculture, Taihoku University, Formosa, Japan.*

1927 ‡ Jackson, C. H. N., *Cayton, York-road, St. Albans.*
1917 ‡ Jackson, Miss Dorothy J., *North Cliff, St. Andrews, Fife.*
1932 Jackson, T. H. E., *Kapretwa, Kitale, Kenya Colony.*
1927 Jacobi, Prof. A., *Museum für Tierkunde und Volkerkunde, Dresden, Germany.*
1930 James, H. C., Ph.D., *Scott Agricultural Laboratories, P.O. Box* 338, *Nairobi, Kenya Colony.*
1920 James, Russell.
1914 ‡ Janse, Prof. A. J. T., D.Sc., *1st-street, Gezina, Pretoria, S. Africa.*
1898 ‡ Janson, Oliver J., 13, *Fairfax-road, Hornsey*, N. 8.
1927 Janson, W. H., *Sibylla, Priory-gardens, Highgate*, N. 6.
1932 Jeannel, Dr. R., *Museum National d'Histoire naturelle, rue de Buffon, Paris, Ve.*
1928 ‡ Jeddere-Fisher, Major H. C., *Woodlands Corner, Littlehampton, Sussex.*
1924 ‡ Johnston, H. B., M.A., 5, *Scroope Terrace, Cambridge, late Wellcome Laboratory, Khartoum, Sudan.*
*1920 ‡ Johnstone, Douglas.
1927 Johnstone, J. F., *Courtlands, Clarence-road, Southsea.*
*1908 ‡ Joicey, J. J., F.L.S., F.Z.S., F.R.G.S. (Council, 1921–3), *The Hill Museum, Witley, Surrey.*
1930 ‡ Jones, E. Parry, B.Sc., *Natural History Dept., Marischal College, Aberdeen.*
1924 ‡ Jones, F. Morton, D.Sc., 2000, *Riverview Avenue, Wilmington, Delaware, U.S.A.*
1929 Jones, H. P., *Natural History Museum, Wollaton Hall, Nottingham.*
1925 ‡ Jones, J. R. J. Ll., M.A., *Arranmore, Mill Bay, Cobble Hill, British Columbia.*
1894†‡Jordan, K., Ph.D., F.R.S., V.-Pres. (President, 1929–30; V.-Pres., 1909, 1926; Council, 1909–11, 1924–26, 1931), *The Museum, Tring.*
1910 ‡ Joseph, E. G., M.C., M.A., B.Sc., 23, *Clanricarde-gardens*, W. 2.

1910 ‡ Joy, E. C., *Moore's Hotel, The Leas, Folkestone.*
1912 ‡ Joy, Norman H., M.R.C.S., L.R.C.P., 271, *Kilburn Lane*, W. 10.

1928 Karandikar, K. R., B.A., M.Sc., Ph.D., *Locust Research Laboratory, Pasni, Baluchistan.*
1896†‡Kaye, W. J. (Council, 1906–8), *Caracas, Ditton Hill, Surbiton.*
1925 Kearns, H. G. H., B.Sc., Ph.D., *The Research Station, Long Ashton, nr. Bristol.*
1926 Kelly, R., 59, *Swanston-street, Melbourne, Victoria, Australia.*
1926 Kennedy, Prof. C. H., *Ohio State University, Columbus, Ohio, U.S.A.*
1890 ‡ Kenrick, Sir George H., *Whetstone, Somerset-road, Edgbaston, Birmingham.*
1929 Kenway, H. C., 179, *Brook-street, Brooklyn, Pretoria, S. Africa.*
1931 Kerr, Prof. J. Graham, *The University, Glasgow.*
1904 Kershaw, G. Bertram de B., *Huntsman's Lodge, Wrotham Heath, Kent.*
1906 Keynes, John Neville, M.A., D.Sc., 6, *Harvey-road, Cambridge.*
1900 Keys, James H., 7, *Whimple-street, Plymouth.*
1925 Killington, F. J., A.C.P., 22 *Litchfield-road, Midanbury, Bitterne-park, Southampton.*
1912 ‡ King, H. H., *The Parsonage, Ospringe, Faversham, Kent.*
1889 ‡ King, James J. F.-X., 26, *Ruthvin-street, Kelvinside, Glasgow*, W. 2.
1917 ‡ Kirkpatrick, T. W., *E. African Agric. Res. Station, Amani, via Tanga, Tanganyika.*
1887 † Klein, Sydney T., F.L.S., F.R.A.S., *Lilly's, Chelsfield, Kent.*

1927 ‡ Labouchere, Col. F. A., 15, *Draycott-avenue, Chelsea*, S.W.
1922 ‡ Lacey, Lionel, 529, *Stellar-avenue, Pelham Manor, N.Y., U.S.A.*
1929 Ladell, W. R. S., *Dept. of Agriculture, Bangkok, Siam.*
1925 Laidlaw, F. F., M.R.C.S., L.R.C.P., *Eastfield, Uffculme, Devon.*
1931 Laidlaw, W. B. R., 25, *Westburn-drive, Aberdeen.*
1916 ‡ Laing, Frederick (Council, 1922–24), *British Museum (Natural History), Cromwell-road*, S.W. 7.
1910 ‡ Lakin, C. Ernest, M.D., F.R.C.S., 58, *Portland-place, W.* 1.
1924 Lamb, C. G., M.A., Sc.D., 65, *Glisson-road, Cambridge.*
1911†‡Lamborn, W. A., O.B.E., M.R.C.S., L.R.C.P., *c/o W. S. Tomkinson, Esq., North Hinksey, Oxon.*
1917 Langham, Sir Charles, Bart., *Tempo Manor, Co. Fermanagh.*
1920 ‡ Lathy, Percy I., 90, *Boulevard Malesherbes, Paris.*
1925 Latter, M. P., F.G.S., *Box* 1169, *The Corner House, Johannesburg, S. Africa.*
1895 Latter, Oswald H., M.A., *The Elms, Charterhouse-road, Godalming.*
1927 ‡ Lawson, H. B., *The Links, Worplesdon, nr. Woking, Surrey.*
1930 Lawson, J. A., *Greenacre, Forest Row, Sussex.*
*1899 Lea, Arthur M., Government Entomologist, *Museum, Adelaide, S. Australia.*
1923 ‡ Lean, O. B., *The Moor Plantation, Ibadan, Nigeria, W. Africa.*
1930 ‡ Leeson, H. S., 102, *Mansell-road, Greenford, Middx.*
1910 Leigh, H. S., *Brentwood, Worsley, Manchester.*
1927 Leivers, A. R., 20, *Warwick-road, Mapperley-park, Nottingham.*
1920 ‡ Leman, G. C., *Wynyard*, 152, *West Hill, Putney Heath*, S.W. 15.

1924 ‡ Le Pelley, R. H., Ph.D., *c/o Director of Agriculture, Nairobi, Kenya.*
1930 ‡ Lever, R. J. A. W., *Tulagi, British Solomon Islands, via Australia.*
1903†‡Levett, The Rev. Thomas Prinsep, *Frenchgate, Richmond, Yorks.*
1925 Levick, J., *Ashley House, Handsworth Wood, Birmingham.*
1931 ‡ Lewis, David J., *Shenfield Rectory, Brentwood, Essex.*
1908 † Lewis, John Spedan, F.Z.S., 54, *Orchard Court, Portman-square,* S.W.1.
1922 ‡ Light, S. S.
1930 Lisney, A. A., B.A., *Cremorne, Shankill, Co. Dublin, Irish Free State.*
1919 ‡ Lloyd, Llewellyn, D.Sc., *Zoological Dept., University, Leeds.*
1885†‡Lloyd, R. W. (V.-Pres., 1924, 1928, 1932; Council, 1900–1, 1923–5, 1928–30, 1932–), 1, 5 *and* 6, *Albany, Piccadilly,* W. 1.
1920 ‡ Lodge, George, *Hawkhouse, Upper Park-road, Camberley.*
1903 Lofthouse, T. A., *The Croft, Linthorpe, Middlesbrough.*
1925 ‡ Longfield, Miss C. (Council, 1932–), 20, *Pont-street,* S.W. 1.
1908 ‡ Longsdon, D., *The Flower House, Southend, Catford,* S.E. 6.
1930 Lowe, J. H. B., R.E., 69, *Oakwood Court,* W. 14.
1923 Lowther, R. C., M.B., Ch.B., *Fernleigh, Grange-over-Sands, Lancs.*
*1898 ‡ Lucas, William John, B.A. (Council, 1904–6), 28, *Knight's-park, Kingston-on-Thames.*
1929 ‡ Lyall, Miss Edith M., B.Sc., *The Withies, Steel's-lane, Oxshott, Surrey.*
1903 Lyell, G., *Gisborne, Victoria, Australia.*

1910 ‡ MacDougall, R. Stewart, M.A., LL.D., D.Sc., F.R.S.E. (V.-Pres., 1929; Council, 1928–30), *Ivy Lodge, Gullane, East Lothian.*
1922 ‡ Mace, Herbert, *Faircotes, Harlow, Essex.*
1930 McHardy, J. W., B.Sc., 53, *Liberton-drive, Edinburgh.*
1928 ‡ McKenny-Hughes, A. W., D.I.C., 22, *Stanford-road, Kensington,* W. 8.
1929 ‡ MacLagan, D. Stewart, D.Sc., *Dept. Agricultural Zoology, George-square, Edinburgh.*
1919 McLeod, M. C.
1930 Madwar, S., M.B., Ch.B., D.T.M. & H., *Molteno Institute, Cambridge.*
1899†‡Main, Hugh, B.Sc., F.Z.S. (Council, 1908–10), 55, *Buckingham-road, South Woodford,* E. 18.
1930 ‡ Mansbridge, G. H., *Gonville, Mina-avenue, Langley-road, Slough.*
1892 ‡ Mansbridge, W., *Monrieth, Derby-road, Formby, Liverpool.*
1919 Mansfield-Aders, Dr. W., M.B.E.
1932 Manson, D., M.B., Ch.B., L.D.S., *Cinnamara, Tea Estate, Cinnamara P.O., Upper Assam. India.*
1926 ‡ Mansour, K., B.Sc., *Dept. of Zoology, The Egyptian University, Abbassiah, Cairo.*
1925 ‡ Marks, E.
1920 Marriner, T. F., *Church House, Court-square, Carlisle.*
1895 ‡ Marshall, Sir Guy A. K., C.M.G., D.Sc., F.R.S., F.Z.S. (V.-Pres., 1919, 1924, 1932; Council, 1907–8, 1919–21, 1924–6, 1928–30, 1932–), 48, *Pont-street,* S.W. 1.
1922 Marshall, J. F., M.A., F.Z.S., *Seacourt, Hayling Island, Hants.*
1896 Marshall, P., M.A., B.Sc., F.G.S., *Hautere, Bellevue-road, Lower Hutt, New Zealand.*

1897 Martineau, Alfred H., *Shutteroaks Toll House, Crewkerne, Somerset.*
1919 Marumo, N., *Zoological Institute, Agricultural College, Imperial University, Komaba, Tokyo, Japan.*
1922 ‡ Massee, A. M., *East Malling Research Station, East Malling, Kent.*
1895 Massey, Herbert, *Ivy-Lea, Burnage, Didsbury, Manchester.*
1921 Matsumura, Prof. S., *Hokkaido Imperial University, Sapporo, Japan.*
*1887 Matthews, Coryndon.
1912 Maulik, Prof. S., M.A., *c/o R. Maulik, Clock Tower, Hogg Market, Calcutta, India.*
1916 ‡ May, Harry Haden, *Black Friars Distillery, Southside-street, Plymouth.*
1929 ‡ de Meillon, Botha, *South African Institute for Medical Research, Box 1038, Johannesburg, S. Africa.*
1927 Mellor, J. E. M., M.A., *Cambridge Univ. Horticultural Research Station, School of Agriculture, Cambridge.*
1919 ‡ Mellows, Charles, M.A., *The College, Bishops Stortford.*
1912 ‡ Metcalfe, The Rev. J. W., *The Vicarage, Stoke Canon, Exeter.*
1880 ‡ Meyrick, Edward, B.A., F.R.S., F.Z.S., *Thornhanger, Marlborough.*
1926 ‡ Michelmore, A. P. G., *Saffron Close, Chudleigh, S. Devon.*
1920 ‡ Miller, D., Ph.D., Chief of Dept. of Entomology, *The Cawthron Institute, Nelson, New Zealand.*
1921 Miller, N. C. E., *Dept. of Agriculture, Kuala Lumpur, F.M.S.*
1930 Misra, Dr. A. B., *Hindu University, Benares, India.*
1923 Mitchell-Hedges, F. A., *The Deene, Lamorna, nr. Penzance, Cornwall.*
1902 ‡ Montgomery, A. M., 36, *Twyford-avenue, Acton,* W. 3.
1922 ‡ Moore, A., M.D., *Sundew, Lyndhurst, Hants.*
1899 ‡ Moore, Harry, 12, *Lower-road, Rotherhithe,* S.E. 16.
1927 Moore, H. W. B., *Plan Albion, Berbice, British Guiana.*
1922 Moore, J. W., 151, *Middleton Hall-road, King's Norton, Birmingham.*
1927 Morgan, Capt. H. O., 12, *All Saints-road, Clifton, Bristol.*
1923 ‡ Morison, G. D., B.Sc., Ph.D., *Entomological Dept., Marischal College, Aberdeen.*
1895 †‡ Morley, Claude, F.Z.S., *Monk Soham House, Suffolk.*
1920 ‡ Morris, H. M., M.Sc., *Agricultural Dept., Nicosia, Cyprus.*
1893 Morton, Kenneth J., 13, *Blackford-road, Edinburgh.*
1910 ‡ Mosely, Martin E., 43, *Lansdowne-crescent,* W. 11.
1911 ‡ Moss, The Rev. A. Miles, *c/o Messrs. Booth & Co., Para, Brazil.*
1911 Mounsey, J. Jackson, *Bryn-Tirion, Kingstone, Hereford.*
1931 Moutia, L. A., *Asst. Entomologist, Dept. of Agriculture, Reduit, Mauritius.*
1922 ‡ Moysey, Maj. F., *c/o Col. R. H. Rattray, Halliford House, Lonsdale-road, Newton Abbot, Devon.*
1912 † Mullan, Jal P., M.A., F.L.S., F.Z.S., Professor of Biology, *St. Xavier's College, Lamington-road, Grant-road Post, Bombay, India.*
1925 Mumford, E. P., *Director, Pacific Entomological Survey, Hawaiian Sugar Planters' Assn., Experiment Station, Honolulu, T.H.*
1920 Munro, H. K., B.Sc., *P.O. Box* 513, *Pretoria, South Africa.*
1918 Munro, J. W., D.Sc. (Council, 1927-9), *Imperial College of Science, S. Kensington,* S.W. 7.
1914 ‡ Murray, G. H., *Director of Agriculture, Rabaul, New Britain, Territory of New Guinea, via Australia.*

1922 Musgrave, A., *Australian Museum, Sydney, N.S.W.*
1920 ‡ Myers, J. G., D.Sc., *Mount St. Benedict, Tuna-Tuna, Trinidad, West Indies.*

1926 ‡ Nash, T. A. M., *c/o Dept. Tsetse Research, Kikori, Kondoa, via Dodoma, Tanganyika Territory.*
1903 ‡ Neave, S. A., O.B.E., M.A., D.Sc., F.Z.S., Secretary (Secretary, 1919– ; V.-Pres., 1918, 1931; Council, 1916–18), 41, *Queen's-gate*, S.W. 7, and *Bishop's House, Beaconsfield, Bucks.*
1919 ‡ Nell, Louis, *Imperial Institute of Entomology*, 41, *Queen's-gate*, S.W. 7.
1919 Nelson, W. G. F. (Council, 1922–4), 64, *Lincoln's Inn Fields*, W.C. 2.
1931 Newbold, W., O.B.E., M.A., *Imberley Lodge, East Grinstead, Sussex.*
1926 Newey, H. F., *Craigmore, Coleshill-street, Sutton Coldfield.*
1923 ‡ Newland, Gordon, 1, *Albemarle-street, Piccadilly*, W. 1.
1907 ‡ Newman, Leonard Woods, *Bexley, Kent.*
1913 Newman, L. J. W., 5, *Bernard-street, Claremont, W. Australia.*
1909 Newstead, Alfred, *The Grosvenor Museum, Chester.*
1921 Nicholson, A. J., *University of Sydney, New South Wales, Australia.*
1909 ‡ Nicholson, G. W., M.A., M.D. (Council, 1913–15), *Oxford and Cambridge Club, Pall Mall*, S.W. 1.
1923 Notman, H., F.S.A., *Y-Lightning Ranch, Hereford, Arizona, U.S.A.*

1910 ‡ Oldaker, Francis A., M.A., *The Red House, Haslemere.*
1931 Oliver, W. R. B., Director, *Dominion Museum, Wellington, N.Z.*
1921 Ollenbach, O. C., *Survey of India Dept., Dehra Dun, India.*
1925 Onslow, F. R. D., B.A., F.Z.S., *Effingham House, Little Common, Bexhill-on-Sea.*
1913 ‡ Ormiston, Walter, *New Oriental Hotel, Galle, Ceylon.*

1932 Pagden, H. T., M.A., *Holmstoun, West Byfleet.*
1895 ‡ Page, Herbert E. (Council, 1918–20), *Bertrose, Gellatly-road, St. Catherine's Park*, S.E. 15.
1928 Paine, R. W., Assistant Entomologist, *Dept. of Agriculture, Suva, Fiji.*
1916 Palmer, A. Ray, *Standeford, Baldock-road, Letchworth, Herts.*
1931 Palmer, K. L., *Meadowlea, Gobowen, Shropshire.*
1919 Paravicini, Louis, *Commissioner de la Bourse de Bâle, Bâle, Switzerland.*
*1929 ‡ Parkes, W. Randall, *St. Thomas' Hospital*, S.E. 1.
*1918 ‡ Parris, R. S., *Raymond House, Bramley, Guildford.*
1919 Patton, Prof. W. S., M.B., *School of Tropical Medicine, Pembroke-place, Liverpool.*
1922 ‡ Pearce, The Rev. E. J., 17, *Milton-road, Swindon, Wilts.*
1922 ‡ Pearce, Miss E. K., *East Morden, Wareham, Dorset.*
1927 ‡ Pearman, J. V., 1, *Pembroke-mansions, Oakfield-road, Clifton, Bristol.*
1916 ‡ Peebles, Howard M., 14, *Northwick House, St. John's Wood-road*, N.W.8.
1919 Peed, John, *Aylsham, Norfolk.*
1921 ‡ Pendlebury, Capt. H. M., *Broadlands, Shrewsbury;* Systematic Entomologist, *Federated Malay States.*
1914 ‡ Pendlebury, Major Wm. J. de Monté, M.A., *Broadlands, Shrewsbury.*

1931 ‡ Pennington, K. M., *Michaelhouse, Balgowan, Natal, S. Africa.*
1928 ‡ Perkins, J. F., 4, *Thurlestone-road, Newton Abbot, Devon.*
*1922 ‡ Perkins, M. G. L., 5, *Little Cloisters, Westminster-abbey,* S.W. 1.
1903 † Perkins, R. C. L., M.A., D.Sc., F.R.S., 4, *Thurlestone-road, Newton Abbot, Devon.*
1907 † Perrins, J. A. D., 3rd Seaforth Highlanders.
1897 ‡ Phillips, Capt. Hubert C., M.R.C.S., L.S.A., F.Z.S., 17, *Hereford-road, Bayswater,* W. 2.
1931 Phillips, Capt. J. S., M.C., B.A., *Experiment Station, H.A.P.C., University of Hawaii, Honolulu.*
1903†‡Phillips, Montagu A., F.R.G.S., F.Z.S., 57, *St. George's-square,* S.W. 1.
1917 ‡ Pickard-Cambridge, Arthur W., M.A., D.Litt, *Whinfell, Whirlow, Sheffield.*
1929 Pickles, Alan, B.Sc., 16, *Cambridge-street, Clayton, Bradford.*
1928 Piel, O., *Musée Heude, Université l'Aurore, Shanghai, China.*
1891 ‡ Pierce, F. N., *The Old Rectory, Warmington, Oundle, Northants.*
1932 Pinder, J. E., *Melissa, Belle Vue-road, Salisbury.*
1913 Platt, E. E., 403, *Essenwood-road, Durban, Natal.*
1919 Pomeroy, A. W. Jobbins, *Doveridge, W. Avenue, Half Way Tree P.O., Kingston, Jamaica.*
1921 Ponniah, D., *Agricultural Dept., Kuala Lumpur, Fed. Malay States.*
1930 ‡ Potter, C., B.Sc., *Moxley House, Mount-road, Thundersley, Essex.*
1929 ‡ Potts, W. H., B.A., 7, *Ridge-road, Winchmore Hill,* N. 21.
1884†‡Poulton, Professor Edward B., D.Sc., M.A., F.R.S., F.L.S., F.G.S., F.Z.S., Hope Professor of Zoology in the University of Oxford (Pres., 1903–4, 1925–6; V.-Pres., 1894–5, 1902, 1905, 1922–3, 1927; Council, 1886–8, 1892, 1896, 1905–7, 1922–4, 1927, 1931–), *Wykeham House, Banbury-road, Oxford.*
1919 Praed, C. W. M., *Dalton Hill, Albury, Surrey.*
1922 Price, J., 165, *Corporation-street, Stafford.*
1908 ‡ Prideaux, R. M. (Council, 1917), *Woodlands, Brasted Chart, Sevenoaks.*
1920 ‡ Prior, W. H. T., *Culban, Main-road, New Eltham, Kent.*
1904 ‡ Priske, Richard A. R., 136, *Coldershaw-road, W. Ealing,* W. 13.
1893 ‡ Prout, L. B. (Council, 1905–7), 84, *Albert-road, Dalston,* E. 8.
1910 Punnett, Professor R. C., M.A., *Caius College, Cambridge.*
1926 Puri, Dr. I. M., *Central Research Institute, Kasauli, Punjab, India.*

1922 ‡ Rae, Mrs. Margaret, *Courthill, Birkenhead.*
1923 ‡ Raff, Miss Janet W., M.Sc., *c/o The School of Agriculture, University of Melbourne, Victoria, Australia.*
1912 ‡ Rait-Smith, W. (Council, 1924–6; 1929–31), *Hurstleigh, Linkfield-lane, Redhill, Surrey.*
1924 ‡ Ralfs, Miss E. M., 60, *Clarendon-road, Holland-park,* W. 11.
1916 Ramchandra Rao, Sahib Y., M.A., *Agricultural College, Coimbatore, India.*
1907 ‡ Rayward, A. L., 15, *Vicarage-drive, Eastbourne.*
1928 Reed, F. J., 30 and 32, *Eastover, Bridgwater, Somerset.*
1898 Reuter, Professor Enzio, *Helsingfors, Finland.*
1910 ‡ de Rhé-Philipe, G. W. V., *Birkheads, Reigate, Surrey.*

1927 ‡ Richards, Arthur J., *Rozeldene, Hindhead, Surrey.*
1924 ‡ Richards, O. W., M.A. (Council, 1931–), 30, *Mackenzie St., Slough, Bucks.*
1920 ‡ Richards, P. B., Government Entomologist, *Dept. of Agriculture, United Provinces, Allahabad, India.*
1920 ‡ Richardson, A. W., 28, *Avenue-road, Southall, Middlesex.*
1922 ‡ Richardson, Rev. W. H., 88, *Stone-road, Stafford.*
1921 Riddell, Miss J., 615, *Figueroa-street, Los Angeles, California, U.S.A.*
1930 Ries, D. T., M.S., Ph.D., *Cranbrook Institute of Science, Bloomfield Hills, Michigan, U.S.A.*
1924 Riley, C. F. C., *Dept. of Zoology, University of Manitoba, Winnipeg, Canada.*
1912 ‡ Riley, N. D., F.Z.S. (V.-Pres., 1929; Secretary, 1926–9; Council, 1921–3, 1930), 7, *McKay-road, Wimbledon,* S.W. 20, and *British Museum (Natural History), S. Kensington,* S.W. 7.
1908 ‡ Rippon, Claude, M.A., 28, *Springfield House, Abingdon.*
*1926 ‡ Robbins, J. C., *The Rosery, Limpsfield, Surrey.*
1917 ‡ Roberts, A. W. Rymer, M.A., *Molteno Institute, Downing-street, Cambridge.*
1927 Roberts, J. E. H., O.B.E., M.B., F.R.C.S., 26, *Harley-street,* W. 1.
1930 Roberts, J. I., M.Sc., *The Medical Dept., Nairobi, Kenya Colony.*
1889–1898, 1925 :
‡ Robinson, A., B.A., *Bretanby, Seal, nr. Sevenoaks, Kent.*
1904 ‡ Robinson, Lady, *Kirklington Hall, Newark.*
1921 Roebuck, A., *Midland Agricultural College, Sutton Bonington, Loughborough.*
1908 ‡ Rogers, The Rev. Canon K. St. Aubyn, M.A., *Box* 818, *Nairobi, Kenya Colony.*
1922 Rosa, A. F., M.D., 4, *Bellevue-crescent, Edinburgh.*
1907 ‡ Rosenberg, W. F. H., 57, *Haverstock-hill,* N.W. 3.
1932 Rosevear, D. R., *The Botanic Gardens, Victoria, British Cameroons.*
1888†‡ Rothschild, The Right Hon. Lord, D.Sc., F.R.S., F.L.S., F.Z.S. (President, 1921–2; V.-Pres., 1920, 1923; Council, 1900, 1919), *Zoological Museum, Tring.*
1930 Rothschild, Miss Miriam, 4, *Palace Green,* W. 8.
1890 ‡ Routledge, G. B., *Tarn Lodge, Heads Nook, Carlisle.*
1928 ‡ Russell, A. G. B., M.V.O., 88a, *Cromwell-road,* S.W. 7.
1922 Russell, Frank, *Auldham House, Worksop, Notts.*

1919 ‡ St. Aubyn, Capt. John G., 14, *Purley Knoll, Purley, Surrey.*
1920 St. John, W. St. A., M.R.C.S., L.R.C.P., *Derwent House, Derby.*
1928 ‡ Salt, G., Ph.D., D.Sc., *The Zoological Laboratory, Cambridge.*
1926 ‡ Samman, Miss M., *The Croft, North Ferriby, E. Yorks.*
1910 ‡ Saunders, H. A., 19, *Creffield-road, Colchester.*
1923 ‡ Saunders, L. G., M.Sc., Ph.D., *Dept. of Zoology, University of Saskatchewan, Saskatoon, Canada.*
1920 Scharff, Dr. J. W., 15, *Sandycove-avenue, West Dunlaoghaire, Dublin.*
1901 Schaus, W., F.Z.S., *U.S. National Museum, Washington, D.C., U.S.A.*
1920 Schlupp, W. F., B.Sc., *P.O. Box* 182, *Newcomerstown, Ohio, U.S.A.*
1907 ‡ Schmassmann, W., *Beulah Lodge, London-road, Enfield,* N.
1930 ‡ Scott, Maj. F. B., I.A., *c/o Lloyds (Cox's & King's Branch), Pall Mall,* S.W. 1.

1909 ‡ Scott, Hugh, M.A., Sc.D., F.L.S. (V.-Pres., 1926; Council, 1925–7), *British Museum (Natural History), Cromwell-road*, S.W. 7.
1929 Scott, P. W. A., 646, *Cornwell-st., Victoria, B.C., Canada.*
1911 Selous, C. F., M.D., M.R.C.S., L.R.C.P., 25, *Church-road, Tunbridge Wells.*
1923 Sen, S. K., M.Sc., *Imperial Institute of Veterinary Research, P.O. Muktesar, Kumaun, Dist. Naini Tal, U.P., India.*
1911 †‡ Sennett, N. S.
1931 ‡ Seth-Smith, D. W., M.R.C.S., L.R.C.P., *Zoological Gardens, Regent's Park*, N.W. 8.
1926 ‡ Sevastopulo, D. G., *c/o Ralli Bros., Ltd., Calcutta.*
1931 Seydel, Dr. Charles, *P.O. Box* 712, *Elizabethville, Katanga, Belgian Congo.*
1929 Shannon, Derek, *Gothic Cottage, Four Oaks-road, Four Oaks.*
1930 Sharga, U. S., M.Sc., *Agricultural Dept., Etawah, U.P., India.*
1924 ‡ Sharp, E. P., 1, *Bedfordwell, Eastbourne.*
1925 Shaw, F., *Maadi, nr. Cairo, Egypt.*
1886 Shaw, George T. (Librarian of the Liverpool Free Public Library), *William Brown-street, Liverpool.*
1931 Shaw, J. R., *Oakhurst, Waste-lane, Knowle, Warwickshire.*
1905 ‡ Sheldon, W. George, F.Z.S. (Treasurer, 1918–28; V.-Pres., 1920), *West Watch, Oxted, Surrey.*
1900 †‡ Shepheard-Walwyn, H. W., M.A.,
1923 Sherman, J. D., Jun., 132, *Primrose-avenue, Mt. Vernon, New York, U.S.A.*
1929 Shute, P. G., "*Litorea*," *Temple-road, Epsom.*
1887 †‡ Sich, Alfred (Council, 1910–12), *c/o George Sich, Esq., Grayingham, Farncombe-road, Worthing.*
1911 ‡ Simes, J. A., O.B.E., *Kingsley Cottage, Queen's-road, Loughton, Essex.*
1904 ‡ Simmonds, Hubert W., *Dept. of Agriculture, Suva, Fiji.*
1921 ‡ Simms, H. M., B.Sc., *The Farlands, Stourbridge.*
1929 Simpson, Rev. Robert, M.Sc. *Cranleigh School, Surrey.*
1924 Simpson-Hayward, G. H., *Icomb Place, Stow-on-the-Wold, Gloucestershire.*
1928 Sinton, Major J. A., V.C., O.B.E., I.M.S., M.D., Director, Malaria Survey of India, *Kasauli, India.*
1926 Skinner, G. S., *Usine Ste. Madeleine, Trinidad, B.W.I.*
*1922 Sloane, T. G., *Moorilla, Young, New South Wales, Australia.*
1916 ‡ Smart, Major H. Douglas, M.D., B.S., 172, *High-road, Salway Hill, Woodford Green, Essex.*
1930 Smart, John, B.Sc., 4, *Chalmers-crescent, Edinburgh.*
1920 ‡ Smee, C., Govt. Entomologist, *Zomba, Nyasaland.*
1915 ‡ Smith, A. C., *Horton, Mornington-road, Woodford Green.*
1901 Smith, Arthur, *County Museum, Lincoln.*
1911 ‡ Smith, B. H., B.A., *Casa, Frensham Vale, Lower Bourne, Farnham.*
1929 ‡ Smith, C. Bramwell, 61, *Onslow-gardens, Muswell Hill*, N.10.
1924 ‡ Smith, F. Stanley, *Alpha Cottage, Datchworth, Knebworth, Herts.*
1919 Smith, S. Gordon, F.L.S., *Estyn, Boughton, Cheshire.*
1918 † Smith, W. P., F.Z.S., *Moorlands Broad-road, Sale, nr. Manchester.*
1925 Soliman, H. S., *Entomological Laboratory, Zoological Dept., Cambridge.*
*1885 ‡ South, Richard (Council, 1890–1), 4, *Mapesbury-court, Shoot-up Hill, Brondesbury*, N.W. 2.

1930 ‡ Squire, F. A., B.Sc., *Imperial College of Tropical Agriculture, St. Augustine, Trinidad, B.W.I.*
1930 Staley, John, *British Mosquito Control Institute, Hayling Island, Hants.*
1928 ‡ Steer, W., *East Malling Research Station, East Malling, Kent.*
1910 ‡ Stenton, R., 22, *Milton-road, Harpenden.*
1923 Stewart, A. M., 8, *Ferguslie, Paisley, N.B.*
1922 Stewart, B., *Lovell House, Leeds, Yorks.*
1920 ‡ Stidston, Engr.-Commander S. T., R.N., *Ashe, Ashburton, S. Devon.*
1918 ‡ Stiff, Rev. Alfred T., *All Souls' Vicarage, Brighton.*
1910 ‡ Stoneham, Lt.-Col. Hugh F., O.B.E., F.Z.S., M.B.O.U., *The Stoneham Museum, Kitale, Kenya Colony.*
1915 ‡ Stott, C. E., *Armitage, nr. Stafford.*
1927 Strand, Prof. Dr. Embrik, M.A.N., F.L.S., F.Z.S., etc., *Director, Systematic Zoological Institute and Hydrobiological Station, Latvian University, Riga, Latvia.*
1925 Swierstra, C. J., *Director, Transvaal Museum, Pretoria.*
1876 ‡ Swinton, A. H., *Oak Villa, Braishfield, Romsey, Hants.*
1911 ‡ Swynnerton, C. F. M., *Shinyanga, Tanganyika Territory.*
1920 ‡ Syms, Edgar E., 22, *Woodlands-avenue, Wanstead,* E. 11.

1910 Tait, Robt., junr., *Covertside, Moss-lane, Ashton-on-Mersey.*
1908 ‡ Talbot, G., *Mon Plaisir, Wormley, Surrey.*
1920 ‡ Tams, W. H. T. (Council, 1927–9), 5, *Daisy-lane, Fulham,* S.W. 6.
1916 Tatchell, L. S., *Swanage, Dorset.*
1931 Taylor, J. Sneyd, M.A., Division of Entomology, *P.O. Box* 513, *Pretoria, S. Africa.*
*1903 Taylor, T. H., M.A., *The University, Leeds.*
1914 Temperley, Reginald, *The Manor House, Merricott, Somerset.*
1932 Théry, A. C., 21, *Avenue de la Victoire, Rabat, Maroc.*
1925 Thompson, H. W., *Research Dept. in Agriculture, University College, Cardiff.*
1901 ‡ Thompson, M. L., 40, *Gosford-street, Middlesbrough.*
1928 ‡ Thompson, W. R., Ph.D., D.Sc., *Farnham House Laboratory, Farnham Royal, Bucks.*
1892 Thornley, The Rev. A., M.A., F.L.S., F.R.Met.Soc., *St. Anaels, Carbis Bay, Cornwall.*
1926 ‡ Thorpe, W. H., M.A., Ph.D., *Zoological Laboratory, The Museums, Cambridge.*
1907 ‡ Tillyard, R. J., M.A., D.Sc., F.R.S., F.L.S., Chief Commonwealth Entomologist, *G.P.O., Box* 18, *Canberra, F.C.T., Australia.*
1920 Tinsley, Joseph, *West of Scotland Agricultural College, Morven, Scafield-road, Ayr.*
1897 ‡ Tomlin, J. R. le B., M.A. (Council, 1911–13), 23, *Boscobel-road, St. Leonards-on-Sea.*
1907 ‡ Tonge, Alfred Ernest (Council, 1915–17, 1927–29), *Aincroft, Reigate, Surrey.*
1920 Tonge, Alfred E., *Ashville, Trafford-road, Alderley Edge, Cheshire.*
1914 de la Torre Bueno, J. R., 38, *De Kalb-avenue, White Plains, New York, U.S.A.*

1928 ‡ Tottenham, Rev. C. E., *The Rectory, Rous Lench, nr. Evesham, Worcs.*
1927 Townsend, A., *Leam Grange, Warwick New-road, Leamington Spa.*
1906 ‡ Tulloch, Brig.-Gen. J. B. G., C.B., C.M.G., *Hill-court, Abergavenny, Monmouthshire.*
1895 ‡ Tunaley, Henry, *Castleton, Searle-road, Farnham.*
1910 Turati, Conte Emilio, 4, *Piazza S. Alessandro, Milan, Italy.*
1930 ‡ Turk, F. A., F.Z.S., *Tenterden, Roservygan Hill, Tehidy, nr. Camborne, Cornwall.*
1898 ‡ Turner, A. J., M.D., *Wickham-terrace, Brisbane, Australia.*
1893 ‡ Turner, Henry Jerome, F.R.H.S. (V.-Pres., 1930; Librarian, 1921–9; Council, 1910–12, 1930), *Latemar, West Drive, Cheam, Surrey.*
1931 Tweedie, R. B., "*Blandfords,*" *Chartridge, Chesham, Bucks.*
1923 ‡ Twidle, A., N.S.A., *The Rowans, Godstone Green, Surrey.*

1893 ‡ Urich, F. W., C.M.Z.S., 107, *Frederick-st., Port of Spain, Trinidad, B.W.I.*
1920 ‡ Uvarov, B. P., *British Museum (Natural History), S. Kensington,* S.W. 7.

1923 ‡ Valentine, A., *Grand Hotel, Herne Bay, Kent.*
1922 ‡ Van Someren, V. G. L., C.M.Z.S., *Box* 658, *Nairobi, Kenya Colony.*
1924 ‡ Van Straubenzee, Brig-Gen. Casimir C. H., C.B., C.B.E., 6, *Sussex Mansions, Sussex-place,* S.W. 7.
1931 Vardé, V. P., D.Sc., *Locust Research Laboratory, Agricultural College, Lyallpur, Punjab, India.*
1904†‡Vaughan, W.
1914 ‡ Veitch, Robert, B.Sc., *Dept. of Agriculture, Brisbane, Australia.*

1897 ‡ Wainwright, C. J. (Council, 1901, 1912–14), 172, *Hamstead-road, Handsworth, Birmingham.*
1918 Walford, L. J., *The Cavalry Club, Piccadilly,* W.
1878 ‡ Walker, J. J., M.A., R.N., F.L.S. (President, 1919–20; V.-Pres., 1916, 1921; Sec., 1899, 1905–18; Council, 1894, 1921), *Aorangi, Lonsdale-road, Summertown, Oxford.*
1921 Walker, S., 53, *Micklegate Hill, York.*
1928 Walsh, Mrs. H. S., *Societeits Straet,* 5, *Soekaboemi, Java.*
1919 ‡ Ward, J. Davis, *Limehurst, Grange-over-Sands, Lancs.*
1910 ‡ Ward, John J., *Natura, Woodland-avenue, Coventry.*
1908 ‡ Warren, B. C. S., 14, *Avenue de l'Eglise Anglaise, Lausanne, Switzerland.*
1901 † Waterhouse, G. A., D.Sc., B.E., *Allowrie, Stanhope-road, Killara, New South Wales, Australia.*
1921 Watkinson, The Rev. G., M.A., *Woodfield, Hipperholme, nr. Halifax.*
1918 Watson, J. H., 70, *Ashford-road, Withington, Manchester.*
1923 † West, Lieut.-Col. R. M., M.D., D.S.O., O.B.E., *Wootton Bridge, Isle of Wight.*
1906 ‡ Wheeler, The Rev. George, M.A., F.Z.S. (Secretary, 1911–21; V.-Pres., 1914; Council, 1921), *Ellesmere, Gratwicke-road, Worthing.*
1910 ‡ White, E. Barton, M.R.C.S., *The Mental Hospital, Fishponds, Bristol.*
1918 White, Ronald Senior, *Central Research Institute, Kasauli (Simla Hills), India.*
1930 Whitehouse, Prof. Beckwith, 62, *Hagley-road, Birmingham.*

1923 ‡ Whitfield, F. G. Sarel, *Wellcome Tropical Research Laboratories, Entomological Field Station, Talodi, Kordofan, Sudan.*
1913†‡Whitley, P. N., *Brantwood, Halifax ;* and *New College, Oxford.*
1913 † Whittaker, Oscar, F.R.M.S., 1143, *Esquimalt Avenue, Hollyburn, British Columbia.*
1911–1920, 1925 :
‡ Whittingham, Rt. Rev. A. G., Lord Bishop of St. Edmundsbury and Ipswich, *The Bishop's House, Ipswich.*
1917 ‡ Wickham, Rev. Prebendary A. P., *East Brent Vicarage, Highbridge, Somerset.*
1926 ‡ Wigglesworth, V. B., M.A., M.D., B.Ch. (Council, 1932–), "*Hedgeside,*" *Holtspur End, Beaconsfield, Bucks.*
1923 Wightman, A. J. C., *Aurago, Pulborough, Sussex.*
1922 ‡ Wilkinson, D. S., *Portbyan Hotel, Looe, Cornwall.*
1923 Wilkinson, Harold, *Dept. of Agriculture, Nairobi, Kenya Colony.*
1911 ‡ Williams, C. B., M.A., Sc.D., *Rothamsted Experimental Station, Harpenden, Herts.*
1915 ‡ Williams, H. B., LL.D., *Redmayes,* 79, *Broad-lane, Hampton, Middx.*
1921 ‡ Willmer, E. Nevill.
1922 Wilson, F. E., "*Cyathea,*" *Ferncroft-avenue, E. Malvern, Victoria, Australia.*
*1919 † Wilson, Lt.-Col. R. S., *Army and Navy Club, Pall Mall,* S.W.
1915 Winn, A. F., 32, *Springfield-avenue, Westmount, Montreal, Canada.*
1928 Winter, A. E., 148, *West End-avenue, Harrogate.*
1926 ‡ Womersley, H., *S. Australian Museum, Adelaide, S. Australia.*
1928 ‡ Wood, Hugh, *Rollrights, Milford-on-Sea.*
1919 ‡ Wood, H. Worsley, 37, *De Freville-avenue, Cambridge.*
1905 Woodbridge, F. C., *Briar Close, Latchmore-avenue, Gerrard's Cross S.O., Bucks.*
1925 ‡ Woodcock, A. J. A., M.Sc., *Rhianva,* 65, *Rock-avenue, Gillingham, Kent.*
1925 ‡ Woodward, Capt. G. C., R.N., *Training Ship "Cornwall," Denton, nr. Gravesend, Kent.*
1921 Woolett, G. F. C., *Sipilang, Province Clarke, B.N. Borneo.*
1926 ‡ de Worms, C. G. M., M.A., D.I.C., *Milton-road, Egham, Surrey.*
1922 Wright, A. E., *Burnleigh, Kent Bank-road, Grange-over-Sands.*
1927 ‡ Wright, Rev. W. Rees, M.Sc., 4, *Hyfrydle, Quarry-road, Brynteg, Wrexham.*

1925 ‡ el Zoheiry, M. Soliman, *Plant Protection Section, Ministry of Agriculture, Cairo, Egypt.*

ADDITIONS TO THE LIBRARY

During the Year 1932.

Acerbi (Joseph). Travels through Sweden, Finland and Lapland to the North Cape, in the years 1798 and 1799. 2 vols., illust. 4to. London, 1802. *Purchased.*

Ahrens (August). A. Ahrensii . . . Fauna Insectorum Europae (cura [Fasc. 3–24] E. F. Germar et [Fasc. 3] F. Kaulfuss., 24 Fasc. illust. (col.). obl. 8vo. Halae [1812–1847].
Fasc. I–III, XI–XII, and a complete set of the Lepidoptera. The rest of the work is wanting. *Purchased.*

Aldrich (J. M.). *Sarcophaga* and allies in North America. 8vo. La Fayette, Ind., 1916.
Thomas Say Foundation Publication. Vol. I. *Purchased.*

Arrow (G. J.). The Fauna of British India, &c. Coleoptera Lamellicornia, Pt. III (Coprinae). 8vo. London, 1931. *Secretary of State for India.*

Austen (E. E.) and Hegh (Emile). Tsetse flies. Their characteristics, distribution and bionomics with some account of possible methods for their control. 4to. London, 1922. *Purchased.*

Bartholomew (J. G.), Clarke (W. Eagle) and Grimshaw (P. H.). Atlas of Zoogeography. A series of maps illustrating the distribution of over seven hundred families, genera, and species of existing animals. fol. Edinburgh, 1911.
Bartholomew's Physical Atlas, Vol. V. *Purchased.*

Bastin (Harold). Insects. Their life-histories and habits. 8vo. London, 1913. *Purchased.*

Berthold (Arnold Adolph). Latreille's Naturliche Familien des Thierreichs. Aus dem Französischen, mit Anmerkungen und Zusätsen, &c. 8vo. Weimar, 1827. *Purchased.*

Bertoloni (G.). De duobus insectis *Ulmo campestri* et *Pyro malo* infensis. 4to. Bononiae, 1844. *Purchased.*

Boisduval (J. B. A. D. de). Considérations sur les Lépidoptères envoyés du Guatemala à M. de l'Orza. 8vo. Rennes, 1870. *Purchased.*

Bondar (Gregorio). Os insectos damninhos na Agricultura. Fasc. 1. Pragas da Figueira cultivada. 8vo. S. Paulo (1913). *The Author.*

Borg (John). Scale Insects of the Maltese Islands. 8vo. Malta, 1932. *Dept. Agric. Malta.*

Boselli (F.). Elenco delle specie d'insetti dannosi e lori parassiti ricordati in Italia dal 1911 al 1925. 8vo. Portici (1928). *Laboratorio di Entomologia, Portici.*

Bounoure (Louis). Aliments, Chitine et tube digestif chez les Coléoptères. 8vo. Paris, 1919.
Thèse . . . présentée a la Faculté des Sciences de Paris. *Purchased.*

British Columbia.—Department of Agriculture. Check List of British Columbia Lepidoptera. 8vo. Victoria, B.C., 1906. *Purchased.*

British Museum (Natural History). Illustrated guide to the exhibition galleries. 8vo. London, 1931. *The Trustees.*

Bromilow (Frank). Butterflies of the Riviera. A short account of the Rhopalocera of the Maritime Alps. 8vo. Nice, 1892. *Purchased.*

Buchner (Paul). Tier und Pflanze in Symbiose. 2te . . . Auflage von 'Tier und Pflanze in intrazellularer Symbiose.' 4to. Berlin, 1930. *Purchased.*

Calvert (Amelia Smith) and (Philip Powell). A Year of Costa Rican natural history. 8vo. New York, 1917. *Purchased.*

Cameron (Malcolm). The fauna of British India, including Ceylon and Burma. Coleoptera. Staphylinidae, Vol. III. 8vo. London, 1932. *Secretary of State for India.*

Chapman (Royal N.). Animal ecology, with especial reference to Insects. 8vo. N. York and London. 1931. *Purchased.*

Cheesman (L. Evelyn). Hunting Insects in the South Seas. 8vo. London, 1932.
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Chisholm (George G.). Longman's Gazetteer of the World. With appendix. 4to. London, 1916. *Purchased.*

Claassen (Peter W.). Plecoptera nymphs of America (north of Mexico). 8vo. Springfield, Ill., 1931.
Thomas Say Foundation Publication, Vol. III. *Purchased.*

Collenette (C. L.). Sea-girt jungles. The experiences of a naturalist with the "St. George" expedition. 8vo. London [1926]. *The Author.*

Collinge (Walter E.). (Second) (third and fifth) Report on the injurious insects and other animals observed in the Midland counties during 1904(–1905, 1907). illust. 8vo. Birmingham, 1905–1908.
Wanting first and fourth reports. *Mr. G. Talbot.*

Cosstick (William). A desiderata of the flora, &c., of Eastbourne and the vicinity, consisting of . . . varieties of butterflies . . . moths . . . bees, &c. 18mo. Eastbourne, 1867. *Mr. Francis Hemming.*

Cotes (E. C.) and Swinhoe (C.). A catalogue of the Moths of India. 8vo. Calcutta, 1887.
Printed by . . . the Indian Museum. *Purchased.*

Csiki (Ernö). Magyarország bogárfaunája. Vezérfonal a magyar szent korona országainak területén elöforduló bogarak megismerésére. Kötet 1. Általános rész.—Adephaga: 1. Caraboidea. 8vo. Budapest, 1905–08.

Dahl (Georg). Coleoptera und Lepidoptera. Ein systematisches Verzeichniss, mit beygesetzten Preisen der Vorräthe. 8vo. Wien, 1823.
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Dalman (Johann Wilhelm). Prodromus monographiae Castniae generis Lepidopterorum. 4to. Holmiae, 1825. *Purchased.*

Dawson (J. F.) and Clark (Hamlet). A rearrangement of the nomenclature and synonymy of those species of British Coleoptera . . . comprised under the sections Geodephaga, Hydrodephaga, and part of Philhydrida, being the first portion of a general British catalogue. 8vo. London, 1856.
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Delahaye ( ). [Iconographie des Lépidoptères papillons de France.] [8vo. Paris, 1852.]
No text or title page was issued. *Purchased. Carnegie Grant.*

Derbyshire Entomological Society. The Lepidoptera of Derbyshire by H. C. Hayward. 8vo. [n.p.] 1926. *Purchased.*

Dognin (P.). Note sur la faune des Lépidoptères de Loja et environs (Équateur). Descriptions d'especes nouvelles. 4 Parts. 4to. Paris, 1887.
This work originally appeared in *Le Naturaliste*, ser. 2, 1887. *Purchased.*

Doncaster (Arthur). Label list of British butterflies and moths to the end of the Pyrales. With English and Latin names. 8vo. London, 1894.
Printed in double column on one side of the paper. *Dr. S. A. Neave.*

Eecke (R. Van). De Heterocera van Sumatra. Eerste Deel. 8vo. Leiden, 1930.
Originally published in *Zool. Meded. Leiden*, 8–12, 1925–1929. *Purchased.*

Ehret (Georgio Dionysio). Plantae et Papiliones rariores, depictae et aeri incisae. fol. [London], 1748–59. *Mr. H. J. Turner.*

Erschoff (N.). Catalogue des Lépidoptères des environs de St. Pétersbourg, arrangé d'après le Catalogue du Dr. O. Staudinger. 8vo. St. Petersburg, 1866.
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Fauconnet (L.). Catalogue raisonné des Coléoptères de Saone-&-Loire. 4to. Creusot, 1887.
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Genouville (E. R.). Histoire naturelle des Lépidoptères ou Papillons diurnes, des environs de Paris. Livr. 1. 8vo. Paris, 1820.
The author died in 1820 and the work was taken over by Godart who replaced this text and continued it under the same title. At Godart's death it was completed by Duponchel. *Purchased.*

Grouvelle (A.). Mémoires entomologiques. Études sur les Coléoptères. 2 fascs. 4to. Paris. 1916–19.
[Déposé a la Société entomologique de France.] *Mr. H. G. Champion.*

Harpe (J. C. de La). Catalogue des Phalénites suisses. 8vo. n.d. n.pl. [1853].

Hingston (R. W. G.). A naturalist in the Guiana forest. 8vo. London. 1932.
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Holland (W. J.). The Butterfly Book. A popular and scientific manual, describing and depicting all the butterflies of the United States and Canada. New and . . . revised edition. 4to. New York, 1931. *Dr. K. Jordan.*

Horváth (Géza). General catalogue of the Hemiptera. Fasc. II. Mesoveliidae. 1929.

Howard (L. O.), Dyar (H. G.) and Knab (F.). The mosquitoes of North and Central America and the West Indies. 4 vols. illust. 4to. Washington, 1912–1917.
Wanting Vols. 1–2.
Carnegie Institution of Washington. Publication No. 159. *Purchased.*

Hussey (Roland F.). General Catalogue of the Hemiptera. Fasc. III. Pyrrhocoridae . . . with bibliography by E. Sherman. 1929.

Imms (A. D.). Social behaviour in Insects. 8vo. London (1931).
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Janse (A. J. T.). Check-list of the South African Lepidoptera Heterocera. 8vo. Pretoria, 1917.
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Joy (Norman H.). A practical handbook of British Beetles. 2 vols. 4to. London (1932).
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Kessel (Fritz). Fauna brasiliensis coleopterologica. Beitrag 1–2. fiscp. Berlin-Spandau, 1932.
Typewritten on one side of the paper.
50 copies of the work have been made. *The Author.*

Kroeber (O.). Diptera of Patagonia and South Chile. Part V. fasc. 2.—Tabanidae.
British Museum (Nat. Hist.) 8vo. 1930.

Kunzé (Richard Ernest). Entomological materia medica; or an enumeration of insects employed by physicians as remedial agents. Read at the World's Medical Congress . . . Chicago . . . 1893. 8vo. [n.pl.] [n.d.]. *Purchased.*

Lewin (John William). A natural history of the Lepidopterous insects of New South Wales, collected, engraved, and faithfully painted after nature. 4to. London, 1822.
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Linker (Johann Jacob), Freyherr von. Der besorgte Forstmann. Eine Zeitschrift über Verderbniss der Wälder durch Thiere, und vorzüglich Insecten überhaupt, besonders aber durch die jetzt in Teutschland herrschenden Kiefer = Fichten = Tannen = und Birken = Raupen. Gesammelt und herausgegeben von . . . Linker. Bd. 1. 8vo. Weimar, 1798.
Published in 4 " Stücke." *Mr. L. B. Prout.*

Lyon.—Chambre de Commerce.—Laboratoire d'Études de la Soie de la condition publique des Soies.
Essai de Classification des Lépidoptères producteurs de Soie. 7 fasc. illust. 1897–1911.
1. Attaciens. J. Dusuzeau and L. Sonthonnax. 1897.
2. Actiens, Saturniens. L. Sonthonnax. 1899.
3. Saturniens. L. Sonthonnax. 1901.
4. Saturniens. L. Sonthonnax. 1904.
5. Saturniens. A. Conte. 1906.
6. Pinarides. A. Conte. 1909.
7. Bombycides. [A. Conte.] 1911.

Originally published in " C. R. Trav. Lab. Soie, Lyon," **8–14**, 1895–1910.
Purchased.

Maassen (J. Peter) [1810–1890]. Beiträge zur Schmetterlingskunde. Herausgegeben von J. P. Maassen ([and afterwards] G. W. Weijmer and A. Weyding). 5 lief. 50 pls. (col.), with lithographed explanations and wrapper. fol. Elberfeld, 1869–1885.
[Wanting lief. 4–5.] *Purchased.*

Mabille (Paul). Histoire naturelle des Lépidoptères (de Madagascar). 2 tom. 4to. Paris, 1885–7.
Grandidier (A.). Hist. phys. nat. polit. Madagascar, Vol. 18, tom. I; Vol. 19, tom. II.
Pls. Va, XXa, XXXb, XXXVIa, and LXIa are wanting. *Purchased.*

Mabille (Paul, and Vuillot ( ). Novitates Lepidopterologicae. 4to. Paris [1890–1895].
Pp. 105–106 appear to be wanting.
Without title-page. *Purchased.*

Matsumura (S.). Thousand insects of Japan. 4 vols. illust. 4to. [n.pl.], n.d. (c. 1914).
Wanting Vol. I. The text is in Japanese throughout. Vol. III is dated 1914.
Mr. W. H. T. Tams.

Matsumura (S.). Illustrated common insects of Japan. 4to. [n.pl.] 1929–.
Vol. I. Butterflies. 1929.
II. Moths. 1930.
III. Beetles. 1931.
IV. Hymenoptera, Diptera, Rhynchota. 1932.
The text is in English and Japanese. *Purchased.*

Matsumura (S.). The illustrated thousand insects of Japan. 4to. [n.pl.], 1930–.
Vol. I. Rhynchota. 1930.
II. Hymenoptera. 1930.
The text is in Japanese throughout, with the addition of English descriptions of the new insects described. *Purchased.*

Matsumura (S.). 6000 illustrated insects of Japan-Empire. 8vo. [n.pl.], 1931.
The text is wholly in Japanese. *Purchased.*

Meyrick (E.). Exotic Microlepidoptera. Vol. IV, pts. 1–11. *The Author.*

Mossop (John). [British Butterflies and Moths in verse and prose. Illustrated with numerous drawings from Nature of the larvae and pupae with the plants on which the former usually feed. Also several specimens of other orders of Insects. 4to. 1844.]
[An apparently unpublished manuscript.] *Purchased.*

Nagel (G.). Versuch einer lepidopterologischen Encyclopädie für angehende deutsche Schmetterlingssammler. sm. 8vo. Helmstädt, 1809. *Mr. L. B. Prout.*

Needham (J. G.) and Claasen (P. W.). A monograph of the Plecoptera or Stoneflies of America north of Mexico. 8vo. La Fayette, Ind., 1925.
Thomas Say Foundation Publication. Vol. II. *Purchased.*

Newbery (E. A.) and Sharp (W. E.). An exchange list of British Coleoptera. 8vo. Plymouth, 1915.
An Addenda dated 1916, and further " Addenda " to Dec. 31st, 1920, have been added.
Title from wrapper. *Mrs. S. Image.*

Nielsen (E.). The biology of Spiders. With especial reference to the Danish fauna. 2 vols. illust. 8vo. Copenhagen, 1932. *Mr. H. J. Turner.*

Ormerod (Eleanor A.). The Hessian Fly *Cecidomyia destructor* in Great Britain: being observations and illustrations from life. 8vo. London, 1886.
Mr. H. W. Andrews.

Pagenstecher (Arnold). Beiträge zur Lepidopteren-Fauna des Malayischen Archipels. 14 pts. illust. 8vo. Wiesbaden, 1884–.
[I]. Beiträge zur Lepidopteren-Fauna von Amboina, 1884.
II. Heterocera der Insel Nias (bei Sumatra), 1885.
III. Heteroceren der Aru-Inseln, Kei-Inseln und von Südwest-Neu-Guinea, 1886.
IV. Über die Calliduliden, 1887.
V. Verzeichniss der Schmetterlinge von Amboina nebst beschreibung neuer Arten, 1888.
VI. Über Schmetterlinge von Ost-Java, 1890.
VII. *Ornithoptera Schoenbergi*, Pagenstecher nov. spec., 1893.
VIII. Über das muthmaasliche Weibchen von *Ornithoptera Schoenbergi*, Pag., 1893.
IX. 1. Über Javanische Schmetterlinge. 2. Über einige Schmetterlinge von der Insel Sumba, 1894.
X. Über Schmetterlinge aus dem Schutzgebiete der Neu-Guinea-Compagnie, 1894.
XI. Über die Lepidopteren von Sumba und Sambawa, 1896.
XII. i. Ueber einige Schmetterlinge von der Insel Baweon bei Java. ii. Ueber Lepidopteren von den keinen [sic] Sunda-Inseln, Sumba, Sambawa, Alor. iii. Ueber einige Heteroceren von Lombok, 1898.
XIII. Über die geographische Verbreitung der Tagfalter im Malayischen Archipel, 1900.
XIV. Über die Gattung *Nyctemera* Hübn. und ihre Verwandten, 1901.
[Originally published in " Jahrb. nassau. Ver. Naturk," 37–54.] *Purchased.*

Pagenstecher (Arnold). Die geographische Verbreitung der Schmetterlinge. 8vo. Jena. 1909. *Purchased.*

Paiva (Antonio da Costa). Descripção de dois Insectos Coleopteros de Camboja nas costas-orientales do Oceano Indico. 8vo. Lisbon, 1860. *Purchased.*

Pallas (Peter Simon). Voyages . . . en différentes provinces de l'Empire de Russie, et dans l'Asie septentrionale; traduits de l'Allemand, par Gauthier de la Peyronie. 5 Tom. and Atlas. 4to and fol. Paris, 1788–93. *Purchased.*

Paris.—Muséum National d'Histoire Naturelle. Catalogue de la collection de Lépidoptères du Museum, &c. Par E. Boullet et F. Le Cerf. I. Famille Papilionidae. 8vo. Paris, 1912. *Purchased.*

Piepers (M. C.) and Snellen (P. C. T.). The Rhopalocera of Java. 4 pts. illust. col. 4to. The Hague, 1909–1918.
[I]. Pieridae. 1909.
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[III]. Danaidae, Satyridae, Ragadidae, Elymniadae. 1913.
[IV]. Erycinidae, Lycaenidae. 1918.
Purchased.

Pontoppidan (Erich Ludvigsèn). The Natural History of Norway . . . Translated from the Danish original. 2 pts. [in 1 vol.]. fol. London, 1755.
Pp. 219–220 do not exist. *Purchased.*

Pontoppidan (Erich Ludvigsen). [Den Danske Atlas eller Konges Riget Danemark, &c. Photostat copy of Vol. I. pp. 664–701, pls. 29–30. sm. 4to. Kiobenhavn, 1763.] *Purchased.*

Preiss (Paul). Abbildungen hervorragender Nachtschmetterlinge aus dem indo-australischen und südamerikanischen Faunengebiet mit erläuterndem Text. fol. Coblenz, 1888.
The wrapper is entitled "Abbildungen ansehnlicher Vertreter der exotischen Nachtschmetterlinge mit erläuterndem Text." Heft. 1. *Purchased.*

Preiss (Paul). Neue und seltene Arten des Lepidopteren—genus *Castnia*. fol. Ludwigshafen a.R., 1899. *Purchased.*

Punnett (Reginald Crundall). Mimicry in Butterflies. 8vo. Cambridge, 1915. *Purchased.*

Ragonot (E. L.). Nouveaux genres et espèces de Phycitidae et Galleriidae. 1888. *Prof. T. D. A. Cockerell.*

Rebel (Hans). Der Ailanthusseidenspinner, ein heimisch gewordener Grossschmetterling, seine Lebensweise und Zucht, Rassen, Verbreitung und Einbürgerung, sowie dessen Bedeutung als Seidenspinner. 8vo. Wien, 1925. *Purchased.*

Ridgway (Robert). Color standards and color nomenclature. 8vo. Washington, D.C., 1912. *Purchased.*

Robson (Guy Coburn). The species problem. An introduction to the study of evolutionary divergence in natural populations. 8vo. Edinburgh, &c., 1928.
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Rockstroh (Heinrich). Anweisung, wie Schmetterlinge gefangen, ausgebreitet, benennet, geordnet und vor Schaden bewahrt werden mussen. Mit einem Anhange, welcher lehrt, wie Schmetterlinge aus Raupen auferzogen werden. 2te. . . . Auflage. sm. 8vo. Leipzig, 1825. *Mr. L. B. Prout.*

Roepke (W.). De Vlinders van Java. 4to. Batavia, 1932.
Presented. E. Dunlop & Co., Batavia.

Ross (Hermann). Praktikum der Gallenkunde (Cecidologie). Entstehung, Entwicklung, Bau der durch Tiere und Pflanzen hervorgerufenen gallbildungen sowie Ökologie der Gallenerreger. 8vo. Berlin. 1932.
Biologische studienbücher XII. *Purchased.*

Roubal (Jan). Katalog Coleopter (Brouků) slovenska a podkarpatska na základě bionomickém a zoogeographickém a spolu systematický doplněk Ganglbaurových "Die Käfer von Mitteleuropa" a Reitterovy "Fauna germanica."————Catalogue des Coléoptères de la Slovaquie et de la Russie subcarpathique, &c. Pte. I. 8vo. Praha, 1930. *Purchased.*

Rowland-Brown (H.). Butterflies and moths at home and abroad. 4to. London, 1912.
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Royal College of Surgeons of England. List of the Transactions, Periodicals and Memoirs in the Library of the . . . College. 2nd Edition. 8vo. London, 1931. *The College.*

Saussure (Henri L. F. de). Etudes sur la famille des Vespides. 3 pts. illust. (col.). 8vo. Genève and Paris, 1852–1858.
I. Monographie des Guêpes solitaires, ou de la tribu des Euméniens . . . servant de complément au Manuel de Lepeletier de Saint-Fargeau, &c. 1852.
II. Monographie des Guêpes sociales, ou de la tribu des Vespiens, &c. 1853–1858.
III. Comprenant la monographie des Masariens et un supplément à la monographie des Euméniens. 1854–1856. *Purchased.*

Schaum (H.). Catalogus Coleopterorum Europae. In Verbindung mit G. Kraatz und H. v. Kiesenwetter herausgegeben von H. Schaum. 8vo. Berlin, 1859.
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Schaus (W.). American Lepidoptera: illustrations of new and rare species. Part 1†. fol. London, 1892.
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Schioedte (Johann Georg). Beretning om Angreb af Insekter paa 1. Hveden. 2. Naaleskovene. Hermed som Bilag: En Tegning af Hvedemyggen. 8vo. Kjöbenhavn 1855. *Mr. H. W. Andrews.*

Schnack (Friedrich). Im Wunderreich der Falter. Erlebnisse und Abenteuer. 8vo. Berlin, 1930. *Purchased.*

Schuetze (K. T.). Die Biologie der Kleinschmetterlinge unter besonderer Berücksichtigung ihrer Nährpflanzen und Erscheinungszeiten. 8vo. Frankfurt a.M., 1931. *Purchased.*

Semper (Carl). Lepidópteros recolectados en las islas Filipinas per el Dr. Carlos Semper. fol. [n.d. n.pl.]
Printed in double column. *Purchased.*

Sharpe (Emily Mary Bowdler). Monographiae Entomologicae, &c. 1. A Monograph of the genus *Teracolus*. Pts. 1–11. 4to. London, 1898–1902.
Without title-page or wrappers. *Purchased. Joicey Library.*

Shelford (Victor E.). Laboratory and field ecology. The responses of Animals as indicators of correct working methods. 8vo. London, 1929. *Purchased.*

Sinegub (S.). Babochki Rossii. [Butterflies of Russia.] In Russian. 3 pts. illust. (col.). 8vo. Moscow, 1908–1909. *Purchased. Carnegie Grant.*

Southall (John). A treatise of Buggs, &c. 2nd Edition. 8vo. London, 1730. *Mrs. Selwyn Image.*

Stainton (H. T.). June. A book for the country in summer time. sm. 8vo. London, 1856. *Mrs. Selwyn Image.*

Stein (Friedrich). Vergleichende Anatomie und Physiologie der Insecten in Monographien bearbeitet. Erste Monographie. Die weiblichen Geschlechtsorgane der Käfer. fol. Berlin, 1847. *Purchased.*

Tenenbaum (Szymon). Fauna koleopterologiczna wysp Balearskich. (Faune coléoptérologique des îles Baléares). 8vo. Warszawa, 1915. *Mr. Champion.*

Tenenbaum (Szymon). Nowy chrząszcz balearski. (Un nouveau cóleoptère des Balèares.) 8vo. Warszawa, 1915. *Mr. Champion.*

Thomas (Edward). *Edited by.* British butterflies and other insects. 4to. London (1908).
[A collection of chapters by various authors.] *Purchased.*

Tischer (Karl von). Encyclopädisches Taschenbuch für deutsche angehende Schmetterlingssammler zum Gebrauche auf Exkursionen. Herausgegeben von K. von Tischer. sm. 8vo. Leipzig, 1804. *Mr. L. B. Prout.*

Toxopeus (L. J.). De soort als functie van plaats en tijd Getoetst aan de Lycaenidae van het australaziatisch Gebied. 8vo. Amsterdam. 1930. *Purchased.*

Vieweg (Carl Friedrich). Tabellarisches Verzeichniss der in der Churmark Brandenburg einheimischen Schmetterlinge. 2 Hft. illust. (col.). 4to. Berlin, 1789–1790.
The author's name appears only on the title-page of Hft. 2. *Purchased.*

Wakefield (Priscilla). An introduction to the Natural History and classification of Insects in a series of . . . letters. 8vo. London, 1816. *Purchased.*

Ward (John J.). Insect biographies with pen and camera. 8vo. London, n.d. *Purchased.*

Wasmann (Erich). Die Ameisenmimikry. Ein exakter Beitrag zum Mimikryproblem und zur Theorie der Anpassung. 4to. Berlin, 1925.
Abh. theoret. Biol. **19**. *The Author.*

Watson (J. Henry), The wild Silk moths of the world, with special reference to the Saturnidae. Delivered before the Textile Society, Manchester School of Technology, 1911. 4to. [Manchester], 1911.
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[Vol. 2 is prefaced by a List of the scientific writings of William Henry Edwards.] *Purchased.*

Weyenbergh (Hendrik), junr. Beiträge zur Anatomie und Histologie der Hemicephalen Dipteren-Larven (der Gattung *Ctenophora* Meig.), Inaugural-dissertation . . . der philosophischen Facultät zu Göttingen im Jahre 1871. 8vo. Haarlem, 1872.
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Wheeler (William Morton). Demons of the Dust. A study in Insect behaviour. 8vo. London [1931].
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Dr. G. B. Longstaff, cost of plates for Dr. Dixey's paper on New Pierines, £32.

1916.

Dr. T. A. Chapman, for plates, £68 7*s.* 3*d.*

1917.

Mrs. Meldola, for books for the Library, £31 10*s.*
E. E. Green, large binocular microscope.

1919.

Dr. T. A. Chapman, F.R.S., cost of plates to illustrate his papers, £56 19*s.* 3*d.*

1920.

Donations in aid of the purchase of 41 Queen's Gate—
Dr. G. B. Longstaff, £1000.
The Honble. N. C. Rothschild, £500.
Dr. H. Eltringham, Sir G. H. Kenrick, The Rev. F. D. Morice, W. G. Sheldon, each £100.
R. Adkin, G. T. Bethune-Baker, Dr. T. A. Chapman, W. M. Christy, H. Massey, Prof. E. B. Poulton, each £50.
B. H. Crabtree, E. E. Green, Dr. G. A. K. Marshall, G. A. J. Rothney, each £25.
H. E. Andrewes, £21.
H. J. Elwes, E. B. Nevinson, G. T. Porritt, O. Whittaker, each £20.
Dame Alice Godman, book-shelves and fittings for the Library.
J. J. Joicey, in aid of the furnishing of 41 Queen's Gate, £100.
Dr. T. A. Chapman, F.R.S., cost of plates to illustrate his paper, £30.

1921.

Donations in aid of the purchase of 41 Queen's Gate—
The Rt. Hon. Lord Rothschild, £105.
W. M. Christy, £50, making with a similar donation in 1920, £100 in all.
W. G. F. Nelson, £63, reduction of solicitor's charges.
W. J. Kaye, £50.
W. Schmassman, £50.
R. Adkin, £40, cancellation of debentures drawn.
E. C. Bedwell, £28 7*s.* 6*d.*, reduction of surveyor's charges.
H. Willoughby Ellis, £26 5*s.*
Lt.-Col. R. S. Wilson, £25.
H. St. John Donisthorpe, £21.
Miss E. F. Chawner, £20.
Sir John T. D. Llewelyn, Bart., £20.
K. J. Morton, £20.
J. J. Joicey, Lantern and Stand for the Meeting Room.
Dr. T. A. Chapman, F.R.S., £29 5*s.*, to illustrate his paper in the Transactions, 1920.
The Rt. Hon. Lord Rothschild, £22 15*s.* 4*d.*, cost of plates in the Proceedings for 1920.
Jesus College, Oxford, through Prof. E. B. Poulton, F.R.S., £100.

1922.

Donations in aid of the purchase of 41 Queen's Gate—
The Misses Chapman, in memory of their brother, the late Dr. T. A. Chapman, F.R.S., £500.
G. A. J. Rothney (bequest), £150.
R. Adkin, £70, cancellation of debentures drawn.
E. E. Green, £25 (making £50 in all).
W. H. B. Fletcher, £25.
Sir A. Buchan-Hepburn, Bart., £20.
E. W. Adair, £20.
The Misses Chapman, two bookcases.

1923.

Donations in aid of the purchase of 41 Queen's Gate—
The Honble. N. C. Rothschild (bequest), £1000.
R. Adkin, £90, cancellation of debentures drawn (making £200 in all)
A. C. F. Morgan, £20.
H. J. Turner, £20.

1924.

Donations in aid of the purchase of 41 Queen's Gate—
E. B. Bostock, £21.
Miss M. E. Fountaine, £20.
H. H. C. J. Druce (bequest £1000), interest to be spent on new books.
Prof. E. B. Poulton, F.R.S., authorised contribution from the Fund for promoting the study of organic and social evolution, presented to the University of Oxford by Professor J. Mark Baldwin, £130 15*s.* 4*d.*
Jesus College, Oxford, through Prof. E. B. Poulton, F.R.S., £125.
H. Willoughby Ellis, contribution towards new electric light installation at 41 Queen's Gate, £50.

1925.

A. H. Jones (bequest) £100.
G. T. Bethune-Baker, £30, towards the cost of the plates in his paper.
E. A. Elliott, in continuation of his practice since 1908, Wytsman's "Genera Insectorum," amounting to a total value of £225.
The Royal Society, £100, towards the cost of Mr. H. S. Pruthi's paper.

1926.

The Royal Society, £150, towards the cost of Mr. Warren's paper.

1927.

Rev. F. D. Morice (bequest) £200.
Prof. E. B. Poulton, F.R.S., authorised contribution from the Fund for promoting the study of organic and social evolution, presented to the University of Oxford by Professor J. Mark Baldwin, £40 16*s.*

1928.

Col. J. W. Yerbury (bequest) £50.

1929.

The Empire Marketing Board, £96 8*s.* 5*d.*, the entire cost of Mr. B. P. Uvarov's paper.
Prof. E. B. Poulton, F.R.S., authorised contribution from the Fund for promoting the study of organic and social evolution, presented to the University of Oxford by Professor J. Mark Baldwin, £85 11*s.*
The Royal Society, £90, towards the cost of Mr. F. W. Edwards' paper.

1930.

R. W. Lloyd, the entire cost of the panelling and ceiling in the new Meeting Room, together with the Presidential Desk and Chair.
R. Adkin, the entire cost of the Epidiascope and screen.
Dr. K. Jordan, £50 donation in aid of building the new Meeting Room.
H. Willoughby Ellis, £50 donation in aid of building the new Meeting Room.
Dr. R. Stewart MacDougall, £110, being the cost of a bookcase and table for the Library, in memory of his wife.
Jesus College, Oxford, through Professor E. B. Poulton, F.R.S., £25.
Mdme. A. de Horrack-Fournier, cost of plate illustrating Mr. Lathy's paper, £20 5*s.*
The Trustees of the Carnegie (U. K.) Fund, £500 for the purchase of books for the Library.
Mrs. Eaton, a selection of books from the Library of her husband.
E. A. Elliott, in continuation of his practice since 1908, Wytsman's "Genera Insectorum."
P. I. Lathy, "Thèses entomologiques," copy No. 2, including a proof set of the plates, uncoloured.

1931.

Empire Marketing Board, towards the cost of Mr. B. P. Uvarov's paper, £231.
Prof. E. B. Poulton, F.R.S., authorised contribution from the Fund for promoting the study of organic and social evolution; presented to the University of Oxford by Professor J. Mark Baldwin, £110.
Jesus College, Oxford, through Prof. E. B. Poulton, F.R.S., £20.
Board of the Carnegie Fund in South Africa, the entire cost of the plates illustrating Prof. A. J. T. Janse's paper.

1932.

Prof. R. Meldola, legacy, £450.
Prof. E. B. Poulton, F.R.S., authorised contribution from the Fund for promoting the study of organic and social evolution; presented to the University of Oxford by Professor J. Mark Baldwin, £50.
Jesus College, Oxford, through Prof. E. B. Poulton, F.R.S., £30.
Dr. F. Morton Jones, cost of plate illustrating his paper, £20 10*s.*

in considerable numbers. I am staying in Sierra Leone a fortnight on my way out to Lagos.

" I shall be interested to hear if there are many recorded instances of butterflies being taken in numbers so far from land; and at night."

Dr. C. B. Williams, who was unable to be present, had kindly written, on October 18 :—

" Many thanks for your note of yesterday on the flight of *Vanessa cardui* in the Atlantic. It will most certainly be interesting if you can get the specimens and find the sexes. I wonder if it would be possible to soften the bodies of some of the females (if there are any) and ascertain the state of development of the eggs. On looking through my book I find there are several other records of flights in this area :—(1) on September 16th, 1866, Herbert records many specimens two hundred miles from Cape Verde and six hundred from Gambia; (2) Buckstone (1926) records that about 1891 his brother saw a flight of many thousands flying towards the west ' off the north-west coast of Africa.' There is, however, no exact date or locality given; (3) about the end of September or early October 1904 Manders saw several flying round when off Cape Verde.

" Including your new record we thus have four cases, in three of which the date is known. Two of these are in September, and the third either September or early October, so it looks as if there was an indication of a season of migration for this area. It is difficult to fit it in with the spring movement further North. Furthermore, Lean, in Nigeria, says that the species appears there in numbers about the end of September, and Heslop (1931) also records sudden abundance at Bende, S. Nigeria, at end of September 1930, and all disappeared by the end of October. Both of these dates correspond well with the records at sea. Farquharson mentioned in his last letter the fact that the ' Painted Ladies ' appeared suddenly in great numbers at times, but unfortunately did not give any date. We have indications that *cardui* crosses the North African desert belt in the east from Sudan to Egypt. It is quite likely to do the same in the west, but at present there is a gap in our knowledge between these September–October flights in the region of 5°–20° north and the appearance of swarms in Algeria about latitude 35° in March and April."

An Aculeate insect, believed to be a *Eumenes*, carrying as prey a Tettigoniid (Locustid), probably a new species.

Prof. Poulton said that he had received from his friend Miss Vinall, at Bongandanga, Basankusu, in the Belgian Congo, the following interesting note together with the insects referred to and exhibited to the meeting :—

" Last Sunday afternoon (8 May, 1932) I was writing at a table on my verandah when I heard a little thud and looking up saw that a Mason Bee (as we call them) was carrying the enclosed insect and finding it (evidently) too heavy, they had both fallen together on the table: the Mason Bee was carrying this insect underneath her, and seeing me jump up for closer examination, flew off. I left the insect on the table where it was dropped, hoping the bee would return to lift up her burden. She came back, fluttered round a few times. I tried to catch her in my net but failed and I saw her no more. Later, I saw the enclosed Mason Bee [Wasp] which

looked just like the one which was carrying the insect, so I send it for you to see. I am sorry I failed to get them together. The insect prey was not quite dead as it was moving its legs."

The insects were determined by my friends Mr. R. B. Benson and Mr. B. P. Uvarov, as the ♀ Eumenid wasp *E. maxillosa*, de G., and the ♂ Tettigoniid, *Gelotopoia* sp., prob. new, nr. *bicolor*, Br. W. It was unfortunate that the actual captor escaped, as the prey is so interesting and hitherto apparently unknown, also not the kind of insect which a *Eumenes* would be likely to take. It was hoped that this question would be settled by observing the habits of these wasps at Bongandanga. The Tettigoniid did indeed appear to be a heavy weight for an insect captor of the size of the *Eumenes*.

The gentle Driver ant "Baongo," discovered by Miss Vinall at Bongandanga, Belgian Congo.

Prof. POULTON said that his friend Mr. H. St. J. Donisthorpe, who had studied the "Baongo" worker ants forwarded by Miss Vinall, was anxious to examine a "soldier," if one could be obtained. Miss Vinall, when informed of this, had kindly sent further material, including many workers larger than those previously sent and one soldier, with the accompanying note :—

"24 *July*, 1932.—I had in my killing-bottle a few 'Baongo' Ants which I caught outside my house, so I hasten to send them off to you in the hope that they will arrive in better condition and be more useful than the last. There is just one specimen of a 'soldier,' larger than the others. So far I have never seen winged forms that resemble these now sent, but we do have swarms of winged ants coming out of the ground at different times of the year : they are, however, quite different I think, but I will send some of them when we next get a swarm."

Mr. Donisthorpe had sent some specimens of Miss Vinall's earlier consignment of "Baongo" to Dr. Santschi, who had determined them as a new variety, named by him **vinalli**, of *Anomma titan*, Sants.* The habits were so remarkably unlike those of all known Driver ants that any information as to the behaviour of *titan* would be welcome.

An Ashanti brass model of the Palm-weevil (*Rhynchophorus phoenicis*, F.) employed for weighing gold.

Prof. POULTON exhibited this beautiful model obtained by Capt. R. P. Wild from Abomposu, Ashanti, and kindly presented to the Hope Department by his friend Mr. Henry Balfour, F.R.S. He had submitted the model to his friend Sir Guy Marshall, who said that it undoubtedly represented the Palm-weevil and was an excellent reproduction. Mr. Balfour had kindly directed him to Capt. R. S.

* Dr. F. Santschi, of Kairouan, Tunisia, has kindly sent me the following description of the "Baongo," of which he had received specimens from Mr. Donisthorpe. They were part of the earlier series posted by Miss Vinall with her letter of 9 January, 1932.—E. B. P.

Anomma titan, Sants., **vinalli**, var. n. ☿ (media et minor). Diffère du type par la couleur plus foncée, la tête et les mandibules entièrement noirâtres (rougeâtres chez *titan*). Gastre brun noirâtre et plus luisant. Angles postérieurs de la tête coniques comme chez *titan*. Du reste semblable. CONGO BELGE: Haut Congo; Basankusu, Bongandanga. (*Miss G. Vinall*) 4 ☿. F. Santschi, 3 Nov. 1932.

Rattray's *Ashanti*, Oxford, 1923, chap. xxv, and his *Religion and Art in Ashanti*, Oxford, 1927, chap. xxviii, in which such brass weights used in weighing gold, and representing a long series of objects, also often representing proverbs, were described and figured, together with the Ashanti method of manufacture by the cire perdue process of metal-casting, set forth in detail on pp. 306–308 of *Ashanti*. An exact copy of the beetle was made in wax, drawn out into a handle at one end—in this specimen probably the front of the head which has an oblique contour as seen from above, suggesting that a projection had been filed away. The wax model was then covered, layer by layer, with a thin wall of fine clay with which powdered charcoal was sometimes mixed. This was then "covered with much coarser clay mixed with palm-nut fibre" or sometimes silk cotton. After hardening, the whole was heated and the melted wax ran out of the duct formed by the handle. Small pieces of brass rod were then placed in a small crucible which was inverted and luted with clay over the end and open duct of the empty mould which was placed, the crucible below, in the furnace—an iron bucket, lined with a two-inch layer of cement and filled with burning charcoal, and having a hole near the base for the nozzle of the bellows. The smith informed Capt. Rattray that he could tell when the metal was melted by carefully watching the colour of the flame, and in about fifteen minutes he declared that this had happened. He then removed the mould with his tongs, "quickly inverting it, and allowed it to cool gradually." The clay was removed and the cast disclosed. "The handle was filed off close to the head and the weight cleaned up and polished."

Although not a strictly entomological subject, Prof. Poulton felt sure that any Fellow who had seen this wonderful cast would welcome a brief account of the method by which it was produced.

Resemblance of a Geometrid moth (*Semiothisa subcretata*, Warr., BOARMIINAE) to a Hesperid Butterfly (*Tagiades flesus*, F.).

Dr. G. D. Hale Carpenter exhibited a specimen of each of the above insects captured by Dr. C. A. Wiggins at Entebbe, on the north shore of L. Victoria on Aug. 1st, 1910, and drew attention to the remarkable resemblance of the underside of the moth to that of the butterfly. *Tagiades flesus* has the greater part of the under surface of the hind-wings of a chalky-white hue, which during flight is very conspicuous. It rests with wings widely outspread, usually on the upper surfaces of leaves, but may be seen sometimes underneath a leaf with a portion of the white hind-wing conspicuously projecting. Trimen (1889, *South African Butterflies*, 3 : 365) and Longstaff (1912, *Butterfly Hunting in Many Lands*, pp. 191, 573) have both commented on the conspicuousness of this common and widely distributed butterfly and the fact that it sometimes rests on the under surfaces of leaves. The moth has the hind-wings similarly white on the under surface, said to be unusual for a member of this genus, by Mr. L. B. Prout who kindly identified the specimen. The type locality is Entebbe.

On the upper surface also the grey-brown coloration, and disposition of darker markings, produce a general resemblance to the butterfly. The upper surface of the hind-wings of *flesus* shows a considerable suffusion with greyish or white scales along the hind margin, but in some of the allied Oriental species there

is a very marked white border to the hind-wing, which would increase the conspicuousness.

Appearances suggest that *Tagiades flesus* may serve as a model for mimicry by the moth; the resemblance being particularly developed, in rather an unusual manner, on the under surface.

Butterflies from the Amazonas attracted by coloured rags, etc.

The Rev. A. Miles Moss from Pará, recently returned from a two and a half months' expedition up the Amazon, exhibited a case containing *Morpho hecuba obidonius*, *Heliconius catherinae*, *burneyi*, *pseudorrhea* and *Euides thales*, and described how he had recently caught these butterflies at Obidos by attracting them down from the tops of the forest trees by waving a small red flag. The first named was also freely drawn to fermented bananas, which he had suspended with string in the forest paths of Obidos.

The early stages of HESPERIIDAE from the Amazonas.

Mr. Miles Moss also illustrated a small selection of Amazonian Hesperiidae, by showing some water-colour paintings of their larvae on the screen, together with some photographs which he had made direct from the leaves, holed and prepared as " tents " by these larvae. In most cases three " tents," of a form characteristic of the particular species and of a dimension to suit its (generally) speedy growth, are alone employed by that species of larva; and the last " tent " is not always retained at full growth and adapted for the puparium.

Wednesday, November 2nd, 1932.

Dr. H. Eltringham, F.R.S., President, in the Chair.

Election of Fellows.

The following were elected Fellows of the Society:—Richard T. Green, M.D., B.S., D.T.M., The Institute for Medical Research, Kuala Lumpur, Federated Malay States; David Manson, M.B., Ch.B., L.D.S., Cinnamara Tea Estate, Cinnamara P.O., Upper Assam, India; John David Gillett, 1, Beulah Road, Walthamstow, E.17; Frederick Carl Almandoz, Dept. of Agriculture, Trinidad, British West Indies; Georges Van Son, The Transvaal Museum, Pretoria, Union of South Africa.

Exhibits.

The Identity of *Papilio rivularis*, Scop.

Dr. L. G. Higgins said that as a result of an examination of the copy of Scopoli " Entomologia Carniolica " exhibited at the last meeting it had become possible to settle a somewhat controversial point in nomenclature. *Papilio rivularis*, Scopoli, has been identified by many authors as *Limenitis camilla*, W. V. nec L. Without going into details it may be said that the text description corresponds much better with *Neptis lucilla*, W. V., and was so determined by Werneberg,

while *camilla* is clearly described by Scopoli as one of the three varieties which he appended to his description of *rivularis*. The figure of *P. rivularis*, no. 443, which is here reproduced shows an unmistakable *Neptis lucilla*. It is clear therefore that the name *rivularis* cannot be applied to *Limenitis camilla*, auct. nec L., which consequently remains without a valid name. He therefore proposed that of *Limenitis schiffermulleri* for the latter insect, in honour of the author of the Vienna

Fig. 1.—*P. rivularis*, Scop., 1763
= *P. lucilla*, Schiff., 1775.

Catalogue, who was the first entomologist who clearly differentiated between these two butterflies. The synonymy of the two species was therefore as follows:—

1. **Limenitis schiffermulleri,** nom. n.

   Papilio camilla, W. V. 1775 et auct. nec L. 1764.

   Limenitis rivularis, Stichel in Seitz, *Macrolep.* et auct. nec Scopoli 1763.
2. *Papilio rivularis*, Scopoli 1763.

   Papilio lucilla, W. V. 1775.

N.B. These two names are probably true synonyms, as Schiffermuller states that his *lucilla* also came from Carinthia.

A remarkable Pierine from the Gold Coast.

Dr. F. A. Dixey exhibited (1) some forms of *Belenois gidica*, Godt., for comparison with a Gold Coast specimen in the Bourke Collection, and (2) outline drawings of the respective scent-scales for comparison with the ordinary type of scent-scale occurring in the genus *Belenois*.

He said: Among the butterflies collected by the late Admiral Edmund Bourke when stationed on the West Coast of Africa in 1866 and again in 1872–74, is a remarkable Pierine form said to have been taken at Abrobonka, Cape Coast Castle.

The neuration of this specimen is that of *Belenois*, and the 1st subcostal of the fore-wing anastomoses with the costal as in several species (*B. mesentina*, *B. severina*, *B. gidica*, etc.) of that genus. The upper surface of both wings is white with a broad dark border, and a dark greyish streak along the costal margin of the fore-wing. On the under surface the fore-wings are white, the hind-wings pale yellow with a faint costal streak of yellow ochre. Both wings with a dark border; broad as on the upper surface, but with a few pale streaks touched with dusky yellow. On neither surface is there any trace of a discocellular spot, or of a dark bar such as is usual in *B. gidica*, passing from the costal margin across the end of the cell on the upper surface of the fore-wing.

The general aspect suggests that of a white female of *B. hedyle*, Cram., a well-

known *Belenois* from the Gold Coast. The abdomen is somewhat distorted, and as far as this feature is concerned I should hesitate to pronounce definitely on the sex without dissection. But on making a preparation of the scales, I found scent-scales present in abundance, proving the specimen to be certainly a male. To my surprise, the scent-scales were undoubtedly those of *B. gidica*, which, as I have elsewhere pointed out, are entirely distinct from those of any other *Belenois*, and indeed from those of any other Pierine known to me.

Forms of *B. gidica* are known from Gambia, and from the Volta River, Gold Coast. Four females were bred by Mr. D. W. Seth-Smith on the Gold Coast in March and May, 1931. All these seem to me to be referable to *B. gidica tschadica* described and figured by Aurivillius in Seitz's *Macrolepidoptera of the World*, **13**: 40, pl. xii. 5. The locality given by Aurivillius is Northern Cameroons, near Lake Chad.

The absence in the present specimen of all dark marks except the black border is very remarkable; but I think it possible that it may belong to the form of which Mr. Seth-Smith's specimens bred in May are examples.

A local race of *Tapinotus sellatus*, F.

Mr. E. C. Bedwell exhibited a local race of *Tapinotus sellatus*, F., from Fleet, Hants, which differ from the usual grey Norfolk form, the ground-colour being of a light rust red, the legs clear red and the velvety black band on the elytra not such a deep black, whilst the longitudinal fine black lines above and below the band are much more strongly indicated. About 8% of the specimens approach the type in colour, except the legs.

The species occurred at the end of August and early September on its usual food-plant *Lysimachia vulgaris*.

Observations on Insects from Mount Troodos in Cyprus.

Mr. J. E. M. Mellor said :—

" I visited Cyprus in July 1929 and spent several days with Mr. Morris, Entomologist to the Government of Cyprus, on Mount Troodos (6604 feet). He was then studying and preparing a report on the Pentatomid bug, *Dolichorus baccarum*, L. This species is said to spend ten months of the year—June to May—at rest under the stones on the top of the mountain, descending to gardens below during May and June to damage succulent crops, such as potatoes and broad beans. Some few bugs were seen crawling over the stones in July. In some places the bugs could be picked up in double handfuls from below large flat stones.

" From material collected at the time a Mutillid, *Smicromyrme pusilla*, Kl., and a Tachinid *Gymnosoma rotundata*, L., were bred.

" Other notable insects on the mountain were two species of yellow Halticid flea-beetles, *Longitarsus pellucidus*, Foudr., and *Ochrosis ventralis kruperi*, Wsc.; two weevils, *Apion radiolus*, Kirby, and *A. aeneum*, F.; immense numbers of small flies, *Helomyza* (*Suillia*) *pallida*, Fln., and *H.* (*S.*) *humilis*, Mg.; a Sphegid wasp, *Ammophila* (*Psammophila*) *hirsuta*, Scop., and a humble-bee, *Bombus terrestris*, L.

" The feature of the fauna was the large number of individuals by which each of the few species present was represented.

" In conclusion I wish to thank Professor Poulton for the trouble he has taken in sending the specimens to the experts on the various groups for determination, and the latter for so kindly identifying them."

Cnipsus rachis from New Caledonia.

Miss L. E. Cheesman exhibited some living examples of the Phasmid, *Cnipsus rachis* from New Caledonia and drew attention to the bright red colour of the wings in this species.

Rare British Beetles.

Mr. H. Donisthorpe exhibited a number of specimens of *Helophorus strigifrons*, Th. (*championi*, Sharp), from a willow swamp in Windsor Forest, where during the last few years he had taken about 30 specimens by sifting moss, and said :—

" This is an exceedingly rare species ; Sharp had taken one or two at Thornhill, Champion five at Guildford, and Blackburn two at Killarney. Recently Mr. Blair has taken a single specimen at Horsham.

" This insect differs from all the other species of the genus in that the flanks of the elytra are more broadly visible on the under surface. It comes nearest to *H. laticollis*, Th., and *H. aeneipennis*, Th. The colour is less metallic, more brown; the elytra more suddenly and strongly dilated behind the shoulders, with a broad reflexed margin; the longitudinal grooves on the head uniformly narrow, and the alternate interstices slightly elevated. From *aeneipennis* it also differs in having the submedian grooves on the thorax only slightly sinuous, instead of being distinctly angled on the inner edge; and from *laticollis* by the punctures in the striae being smaller and more close together, and the palpi longer and narrower."

He also exhibited several specimens of a species of *Stenichnus* (*S. stotti*, Donis.) which he had recently described, and said :—

" When I was staying with my friend Mr. Stott at Armitage in June last I mentioned that I had taken *Stenichnus pusillus*, Müll., rather freely at Slapton Ley, a fortnight ago. He showed me his series of '*pusillus*' taken with ants near Reigate in 1918–25, and as they did not appear to me to be the same insect, he sent me several specimens to compare with mine : I discovered that they were different species, and on further study, that his was a species new to science, and this I have named in his honour. It differs from *pusillus*, Müll., in the antennae being longer and darker; the legs also are more slender, longer and darker, the foveae on the thorax and elytra slightly longer, and the pubescence a little longer. *S. pusillus*, moreover, does not possess the small ridge at the shoulders, and the anterior femora in the male are wider, and straight at the edge, without the upper edge being produced into a point projecting beyond the articulating socket as in *stotti*.

" This species will probably be found mixed in collections under *pusillus*. In the British Collection there is a single *stotti* ♂, taken by Dr. Power, without data, the rest of the series being *pusillus* from Slapton Ley; in Dr. Sharp's collection there are three specimens, two on one card marked '*pusillus* ♂ and ♀' are that species (from Slapton Ley) but both are ♀♀, the third taken by Champion at Staines marked *pusillus* ♂, is a ♀ *stotti* ! Blair has taken *stotti* at Braunton, and

there is a single ♀ in my collection taken with *A.* (*D.*) *fuliginosus* at Tilgate Forest in 1895.

" Many species, in various genera, of the SCYDMAENIDAE have been taken with ants, but very few of them are complete myrmecophiles. They feed on mites, refuse, etc., and would act as scavengers in the nests."

The gregarious resting habits of Danaine butterflies in Australia ; also of Heliconine and Ithomiine butterflies in tropical America.

Prof. POULTON said that he was anxious to hear of further observations on the sleeping habits of butterflies belonging to the chief distasteful groups and providing the principal models for mimicry among diurnal Lepidoptera. He was glad to be able to add the following records and hoped that others would follow, especially among the ITHOMIINAE, DANAINAE and ACRAEINAE.

1. *Australian Danaine, Euploeine and Pierine butterflies and Uraniid moths.*— Mr. W. B. Alexander had kindly recorded the following interesting observations :—

" In response to your request to put down what I can about the social roosting of Lepidoptera in Australia I regret to say that I have been unable to find the notes I made at the time and so must rely on my memory.

" One summer, almost certainly either 1914–15 or 1915–16, a great irruption of *Danaida chrysippus petilia*, Stoll, occurred in South-western Australia. We had at that time only one or two local specimens of this insect in the W.A. Museum at Perth, and I think I am right in saying that I had not seen one myself during the two or three summers I had spent in the State. In the summer to which I refer they were everywhere in the coastal forests from the Swan River down to the south coast, a distance of about 200 miles, as I learnt by enquiry and from specimens which were sent to the Museum. In the same season the little Pierid, *Terias smilax*, Don., appeared in some numbers, though our only previous knowledge of its occurrence in South-western Australia was the record in Waterhouse and Lyell's *Butterflies of Australia*, that a specimen had been captured at Kalgoorlie, over 300 miles inland. A striking feature of the invasion of the *Danaida* was that numbers of individuals congregated on particular trees to roost, either at dusk or during cloudy periods. These special butterfly trees appeared to have been selected haphazard and were not of any particular species, nor had they any special feature in common as far as I could discover.

" The next occasion on which I met with a butterfly roost was in 1922 when I went to Westwood in Central Queensland, 30 miles inland from Rockhampton, to take charge of the prickly-pear experiment station there. About half-a-mile down the valley from the prickly-pear station the stream flowed close along the southern edge of Mount Sebastopol which was on this side very steep, in places almost precipitous. As a consequence this portion of the valley was shaded by the hill for an hour or more before sunset. At one point on the north bank of the stream there were several *Casuarina* trees which were resorted to by *Euploea corinna corinna*, Macl. Towards evening they gathered on the leafless branches in numbers, but I think there were always some of the butterflies settled on the trees at all times of the day. I lived at Westwood for over a year and paid frequent visits to the station during the following two years, and I think the Euploeas frequented these

trees throughout the time I knew the place and that some were to be seen there at all times of year.

" An interesting account of the migratory flight and sleeping assemblages of the Australian Pierine butterflies, *teutonia*, F., and *pythias*, Waterhouse and Lyell, is given on p. 136 of Waterhouse and Lyell's book, to which I have already referred. Of special interest is the observation that ' they always choose for a resting-place those plants or trees that blend most closely with their own colours.' *

" In the winter of 1925 when I spent some time at Cairns in North Queensland a great migration of a large day-flying moth, which was I believe the Uraniid, *Alcidis zodiaca*, Butl., was in progress. For several days they kept flying steadily south along the coast, singly, but in such numbers that several were always in sight. In the aboriginal reserve at Yarabah, in the bay south of Cairns, from which it is separated by a mountainous headland, I found a roost of these moths. In the evening hundreds were congregated on one or two small, leafy trees growing in open forest country not far from the coast, and I think the same trees were occupied on a second occasion when I passed the spot." W. B. A.

2. *Heliconius charithonia, L., in Jamaica.*—Mr. A. W. J. Pomeroy, F.E.S., had kindly sent 24 specimens of *charithonia* (17 ♂, 5 ♀, 2 specimens, ? sex, with wings only) all taken from the same twig, at the Hope River, Jamaica, 800 feet, 28 December 1931. Six of these were exhibited to the meeting. One of them, a female, had been seized by a large bird, and bore a broad beak-mark entering at the anal angle of R. F. W., and crossing the wing, the bill-tip having projected far beyond the costa. The sleeping habits of this species had been carefully studied in Florida by Dr. F. Morton Jones. For references to this and other records of the assemblages of this species, see 1931, *Proc. Ent. Soc. Lond.*, **6**: 4–9.

3. *Heliconius h. hydarus, Hew., in Little Tobago I.*—Mr. H. Lechmere Guppy had written from Trinidad, 27 May 1932, enclosing, with the following notes, wings of the four Little Tobago specimens (3 ♂, 1 ♀) referred to in the accompanying label—" About 12 specimens congregating 6.0 p.m., flying round before settling down "—and exhibited to the meeting. The butterflies appeared to be a local race of *H. hydarus*, being smaller than the typical form and having a bluer sheen, as had been observed by Mr. A. Hall, F.E.S., when visiting the island.

" I am very busy with a catalogue of Trinidad fishes and so have not had much time to do any outdoor observations on Lepidoptera, but I visited the same locality on the St. Ann's River in March and found *Heliconius h. hydarus* carrying on in the manner previously recorded [1931, *Proc. Ent. Soc. Lond.*, **6**: 9 *n.*, 68, 69]. The sleeping-colony in one spot numbered eleven, and the butterflies commenced to gather about 6 p.m. The first-comers get the pick of the perches while those that come later try to jostle them off by flying into them. This may, of course, be only a playful manoeuvre. Finally all comers select perches as near to one another as conditions will permit.

" I may add that on 24th March I observed a colony assembling in a thicket of

* This habit is in sharp contrast with the choice of bare twigs by the Heliconines, and suggests that the Pierine instinct is an adaptation for keeping the migrant swarm together.—E. B. P.

about 300 feet elevation on the island of Little Tobago. I took a few specimens, as I am not sure that it is the Trinidad species, but the same smell is emitted [*Ibid.*: 69 *n.*]. Little Tobago is 240 acres in extent and is well covered with vegetation. Passiflorae are plentiful and birds abundant, including *Paradisea apoda*, introduced from the Aru Islands 22 years ago. I enclose fragments of four *Heliconius*: they were attacked by ants which are a perfect plague in Tobago."

4. *The gregarious sleeping habits of certain Ithomiine and Heliconine butterflies in Brazil.*—The following observations, written at Pará, Brazil, in May 1932, by the Rev. A. Miles Moss, M.A., F.Z.S., F.E.S., Hon. Chaplain for Pará and the Amazon, were sent to his old friend the President, who had permitted them to appear in this series of notes on the sleeping habits of butterflies.

"Referring to Mr. P. Lechmere Guppy's interesting observations on the sleeping habits of a Heliconian and an Ithomiine butterfly in Trinidad (*Proceedings*, **6**: 68, 69: see also p. 9) and Dr. G. D. Hale Carpenter's on the same habit in African Acraeine butterflies (*Ibid.*: 71), it may be worth while to record a recent observation or two of my own in HELICONINAE and ITHOMIINAE. Though the butterflies of the former subfamily are not much in evidence in Pará, and appear to be limited to some 13 species, at least two of the commonest, very much like one another, *Heliconius erato phyllis*, F., and *H. melpomene thelxiope*, Hübn., may frequently be observed* at dusk, congregating in small numbers on the more or less denuded boughs of trees, 10 or 12 feet above the ground. But as this has only been noticed on trees overhanging country lanes outside the city, I cannot regard a stream-bed, with or without water, as a factor of any particular importance, though doubtless the passage-way of a stream may often attract, as being less disturbed than the roadway. One would like to know what our innumerable bats have to say on this subject, and whether the big fruit-eaters, which frequently seize large moths in the neighbourhood of electric arc lights, ever attempt to pluck the distasteful *Heliconius* from its perch. When opportunity offers I mean to explore the precise scent which proceeds from the caustic oil contained in the cellular shell of the cachew nut (locally "cajú"). *Heliconius*, when netted, smells fusty and oily, and even more so do the males of some of the big hawk-moths, like *Cocytius duponchel*, Poey, recalling the cockroach, but I have never noticed any resemblance to the cachew.

"At Bahia, where I happened to be in the middle of September, 1931, the Danaid butterfly *Mechanitis nesaea*, Hübn., occurred in unusual abundance, as observed by many of the residents. On several occasions I noted some hundreds of these butterflies congregating, even early in the afternoon, on the green leaves of bushes shaded by trees on a hillside. I did not wait to see, but have no doubt that they spent the night there, sitting in close formation. *Mechanitis polymnia*, L., is common enough with us in Pará, but I cannot recollect that I ever saw the species settling together in any particular number.

"In Pernambuco *M. nesaea* and *Eueides isabella*, Cram., difficult to distinguish from one another on the wing, were often netted at the same moment, and I think it highly probable that they roost together."

A. M. M.

* The last precise observation was made on 10 May, 1932.

The author of these interesting notes kindly replied to the inquiry whether the different species roosted together :—

" Yes; I am pretty sure that both *Heliconius erato phyllis* and *melpomene thelxiope* assemble together for the night, and are joined by *Eueides thales*, Cram., but I don't think I have ever *noted* more than half a dozen individuals at a time on a single bough. I will try to look out for this on my return. Also at Bahia I am pretty sure that the very large congregations of the common *Mechanitis nesaea* included a sprinkling of the similarly marked *Eueides isabella* in their midst."

" Palmer " or " Palmer-worm " as the name of certain caterpillars.

Prof. Poulton said he had often wondered at the meaning of these words when applied to caterpillars and had recently found the interpretation in Ronalds' *Fly-fishers' Entomology* to which his attention had been directed by his friend Mr. M. E. Mosely. The last words of this interesting work,* treating of the caterpillars of the Garden Tiger Moth and Drinker Moth, were as follows :—" Both rejoice in the familiar name of *Woolly-bears* in some places. Before these spin their cocoons, . . . they wander from their food often to a great distance; and from this circumstance are called *Palmers*. It is probably during these pilgrimages mostly that they fall a prey to the fish through various mischances."

In the same work the larva of *Arctia caja*, L., was the " Red Palmer," the same full-grown the " Black and Red Palmer," the larva of *Spilosoma lubricipeda*, Esp., the " Brown Palmer."

The Oxford English Dictionary quoted, under " Palmer-worm," the following amusing passage :—

" 1608. Topsell *Serpents* (1658) 667. There is another sort of these Caterpillars, who have no certain place of abode, nor yet cannot tell where to finde their food, but like unto superstitious Pilgrims, do wander and stray hither and thither, . . . these have purchased a very apt name amongst us Englishmen, to be called Palmer-worms, by reason of their wandering and roguish life (for they never stay in one place, but are ever wandering)."

The Dictionary also gave one definition of " Palmer " as a verb—" To wander about like a palmer or vagrant; to go about idly from place to place," and stated that the Hebrew word " Gāzām " translated as " palmer worm " in the Old Testament was probably the name for a kind of locust.

It was curious that the name should now be commonly and inappropriately applied to the larvae of *Porthesia similis*, Fuess.

The successful attack of a Trinidad wasp upon a *Papilio* larva.

Prof. Poulton said that he had received the following interesting account of attacks, undeterred by the prothoracic scent-glands, by the Vespid *Polistes canadensis*, L., upon the larvae of *Papilio anchisiades anchisiades*, Esp., written 12 October 1932 and kindly sent to him by Mr. P. Lechmere Guppy of St. Ann's, Port-of-Spain. The wasp had been kindly determined by Mr. R. B. Benson.

" I thought you might be interested in a note I made regarding the behaviour of a *Polistes* wasp (specimen enclosed) observed attacking larvae of *Papilio a.*

* P. 130 of Ed. 5, 1856, Revised, with additions, by Piscator.

anchisiades. This wasp is very abundant along the southern sea-coast of this island, and their paper nests with numerous hexagonal cells are familiar sights everywhere—under palm-leaves, and the branches of trees and shrubs, also under the eaves of the residences. One has to be cautious in walking through the bush, as they often build quite near the ground. Their nests vary greatly in length, from anything up to a foot, with colonies in proportion to size. Their sting is very painful, and although not aggressive, the wasps will attack if any abrupt movement is made near their nests. They are, of course, indefatigable caterpillar-hunters, and I often wondered what would happen if a colony of the offensive-smelling Papilionid larvae was attacked. These larvae are sometimes seen massed around the stem of a Citrus (Orange or Lime) bush where they resemble chunky bits of dead wood. Just outside my bungalow at Palo Seco, quite near the sea, there is a Citrus bush ('Lime') in the garden, and from time to time I was able to watch the behaviour of a wasp,—not necessarily the same wasp every time—and its method of tackling these larvae, of which there was a fairly large colony massed round the stem. It seemed to me that their obscure cryptic appearance deceived the wasp when in flight, not so, however, its infallible antennae. On alighting somewhere near the cluster of larvae, it made use of these organs to find its prey, and at the moment of contact, seemed to gauge the bulk of the one nearest to it which was too great to be removed in one load. Mounting the caterpillar like a tiger on its prey, the wasp seized it with powerful mandibles behind the head, biting into the neck, until it was nearly severed and the caterpillar killed. During this process it is in vain that the caterpillar vigorously pushes out the retractile tentacles, and emits the offensive odour. The wasp then chews up into a pill the portion it has bitten out; thus preparing it for conveyance before flying off to the nest. I did not ascertain the number of wasps engaged in killing these offensive larvae, for only one was observed at each of my visits to the Lime bush. In two weeks' time, however, they were all removed by the wasps, except one, which I collected in time to save it and breed the imago, which proved to be *Papilio anchisiades anchisiades*."

The alligator-like head and thorax of the tropical American *Laternaria laternaria*, L. (FULGORIDAE, Homoptera).*

Prof. POULTON exhibited two examples of this species kindly presented to the Hope Collection by his friend the Rev. A. Miles Moss who had obtained them

* Mr. W. E. China has very kindly sent the following note on *Laternaria* and *Fulgora* :—

Laternaria, L., antedates *Fulgora*, L., by three years. Although this generic name was not accepted by some of the earlier workers such as Spinola, Amyot and Serville, thus creating considerable confusion in the nomenclature of the related genera, there is no doubt at all as to the validity of this genus. Beginning at the nomenclatorial zero, the history of the genotype runs as follows :—

Cicada laternaria, Linn., Syst. Nat., 10th ed., p. 434, 1758.
Laternaria (new genus) *phosphorea*, Linn., Mus. Lud. Ulr., p. 152, 1764 (= *Cicada laternaria*, L., 1758).
Fulgora (new genus) *laternaria*, Linn., Syst. Nat., 12th ed., 1, p. 703, 1767.
Fulgora laternaria, Fabr., Syst. Rhyng., p. 1, 1803.
,, ,, , Burm., Handb. Ent. II, p. 169, 1839.
,, ,, , Spin., Ann. Soc. Ent. France, viii, p. 213, 1839.
,, ,, , Am. & Serv., Hist. Nat. Ins. Hemipt., p. 490, 1843.
Laternaria laternaria, Stål, Hem. Afr., iv, p. 132, 1866.
,, *phosphorea*, Dist., Biol. Cent. Amer., Hom. I, p. 22, 1883.
The genotypical species should therefore be called *Laternaria laternaria*, L. W. E. C.

from the Amazon, probably from Pará. The specimens, which had been kindly determined by Mr. W. E. China, were in beautifully fresh condition and presented a closer resemblance to the Alligator than *Laternaria servillei*, Spin., figured in *Proc. Ent. Soc. Lond.*, **1924 :** pl. A, figs. 1–4. (See also pp. xliii–lii for an account of the terrifying appearance and supposed luminosity of these insects.) In both specimens the glossy, reptile-like appearance of the epicranium was most striking, as also of the whole head, the prothorax and the mesothorax, in fact upon the entire visible surface in the attitude of rest, except the wings. He had not before noticed that the head of *Laternaria laternaria*, L., is represented, in side view, by Westwood in his *Introduction to the Modern Classification of Insects*, 1840, **2 :** 427, fig. 5. The upper " teeth " were shown as a palisade-like series of subquadrate areas, the lower as a finely crenulated line, but it appeared to be evident that the mimetic resemblance had not been observed by the author. Prof. Westwood also quoted on p. 428 the following statement from Kirby and Spence, who, " on the authority of Stedman's *Surinam*, assert that *Fulgora laternaria* makes a loud noise in the evening, like that made by a razor-grinder, and that the Dutch in Guiana call it a *scare-sleep*. Dr. Hancock, however, states that the razor-grinder, or the Aria Aria of the natives, is a species of Cicada." (*Proc. Zool. Soc.*, **1834 :** June 24.)

The Rev. A. Miles Moss said that the exhibited specimens, as well as the closely related narrow-headed species, appear to be fairly common and widely distributed throughout the Amazon and its tributaries. They are of formidable appearance when at rest or with wings expanded, but are perfectly harmless animals, possess no poison, give no light and make no sounds such as are produced by their relatives, the Cicadas. They are, however, much misunderstood and maligned on account of their strange shape and colour, which is undeniably suggestive of a diminutive alligator. Every one is warned not to touch them, save with a stout stick to beat them to earth or against a tree-trunk. The notion that their inflated heads are filled with a deadly poison, that they are blind, and that persons who are unfortunate enough to be run into by one of them on the wing invariably die in 20 minutes, is a widespread but inexplicable myth. One can only suppose that scientific diagnosis was lacking on every occasion, and that such persons, if they did die, must have had weak hearts and died of fright. This belief, however, is shared with an irritating obstinacy, from the shores of the Atlantic to the Andes, not only by the simple and superstitious but perhaps with even greater insistence, in cities like Pará, Manáos and Iquitos, by persons of superior education whose opportunities for the observation of nature are more restricted than those of their humble brethren in the wilds.

" Lantern-fly " and " Flying-snake " are both fanciful terms of no importance, but the former, indicating that the hollow inflated epicranium in front of the head resembles a Chinese lantern of weird shape, is appropriate, *provided that* we are not thereby led to make the erroneous assumption that the insect can give light. In Brazil it is always termed " Jacaranaboia," which is a corruption of the Indian " Jequi-ti-rana-boia," and appears to mean " like a Jacaré " (alligator). In Peru an onomatopoeic word is used for the *Cicada*. With its incessant " *chi-chi* " and deafening whistle, it is known as " Chichara " (prattler); while the Lantern-fly, although unjustifiably, is called " Chichara-machaca " (prattler-bore).

Whether these FULGORIDAE, with their strange forms and colours, are as greedily devoured by monkeys as are the transparent-winged Cicadas is as yet uncertain. On returning to Pará, he hoped to experiment with both, and compare the effects produced on the monkeys in the Zoological Gardens. The Cicadas he had already offered were clamorously accepted every time, and he now hoped to tempt the monkeys with the Fulgorid, placed on the end of a stick, in different attitudes; also to offer the immense black larvae of *Pseudosphinx tetrio*, L., with its yellow rings and red patches, the badly stinging larvae of *Automeris* and *Dirphia* with their armature of spines, the hairy Arctiids, and the still more hairy and stinging larvae of MEGALOPYGIDAE.

As the abdomina of so many FULGORIDAE are furnished with a profuse excrescence of white wax, often trailing like a tail, these insects have naturally to be collected with great care. Consequently it is a fundamental error, sometimes perpetrated by the novice, to preserve them in tubes of alcohol.

The Lantern-fly and several other species of FULGORIDAE are undoubtedly associated with the "marupá," *Simaruba amara*, Simarubaceae, on which tree he had taken or observed them at Pará, Santarem and on the Marmoré river in Bolivia. These insects used also to occur at electric arc lights, but are rarer to-day than they were twenty years ago.

Dr. G. D. HALE CARPENTER gave an account illustrated by lantern slides of further evidence of the attacks by birds on butterflies.

The work of the Pacific Entomological Survey.

Professor E. C. VAN DYKE, a visitor, gave an account of the work being carried out by the Pacific Entomological Survey, and it was resolved to send a communication to the Director of the Survey expressing the Society's interest in this project and its appreciation of the value of the work that is being done.

Wednesday, November 16th, 1932.

Sir T. HUDSON BEARE, Vice-President, in the Chair.

Nominations.

The SECRETARY read the following list of Fellows nominated by the Council as Officers and Council for the ensuing year :—

For President : Prof. E. B. POULTON, D.Sc., M.A., F.R.S.
For Treasurer : Capt. A. F. HEMMING, C.B.E.
For Secretary : S. A. NEAVE, M.A., D.Sc.

For other members of Council :—Prof. W. A. F. BALFOUR-BROWNE, F.R.S.E., Sir T. HUDSON BEARE, B.Sc., F.R.S.E., K. G. BLAIR, B.Sc., H. St. J. K. DONISTHORPE, H. ELTRINGHAM, M.A., D.Sc., F.R.S., Brigadier W. H. EVANS, C.S.I., C.I.E., D.S.O., Major R. W. G. HINGSTON, M.C., K. JORDAN, Ph.D., F.R.S., R. W. LLOYD, Miss C. LONGFIELD, Sir Guy A. K. MARSHALL, C.M.G., D.Sc., F.R.S., O. W. RICHARDS, M.A., N. D. RILEY, V. B. WIGGLESWORTH, M.A., B.Ch., M.D.

Exhibits.

The British Species of Scopaeus.

Mr. H. Donisthorpe exhibited examples of *Scopaeus ryei*, Woll., and *S. abbreviatus*, Rey, and drew attention to the work of Mr. Edmonds of Totnes in connection with this genus, who had recently added the last-named species as well as *S. minutus*, Er., to the British list. He further expressed the opinion that these constitute three distinct species and that *S. erichsoni*, Kol., is also distinct from *S. trosulus*, Woll.

Wings of British, European and N. American Butterflies bearing the marks of attack by enemies, chiefly birds.

Prof. Poulton exhibited the specimens bearing the injuries described below. The interesting example of *Parnassius apollo*, capable of flight although without one hind-wing, was, however, accidentally omitted and will be shown at a future meeting. Unless otherwise stated, all the specimens were kindly presented to the Hope Collection by the captors, and it is hoped that the series bearing such evidence of attack will be continually increased by the help of friends, although in future it will not be necessary to describe the details except in examples of particular interest. It is of the highest importance that there should be available for the study of naturalists a large collection of this kind, and I wish to express my warm thanks to the many kind friends who have helped in bringing it together and will I hope continue to increase its significance.

Epinephile jurtina, L. (*janira*, L.), ♂—L.H.W., 2 remarkable beak-marks, one from direction of costa, other from outer margin, the tips meeting near centre of wing; a gap in margin. Specimen fresh. J. F. Perkins, 2 July, 1932, Dartmoor, S. Devon.

Epinephile hyperanthus, L.—A huge gap mainly torn out of both H.W.s but invading F.W.s; evidently caused when the wings were together. Probably due to a lizard or possibly a very broad-beaked bird. Specimen apparently fresh. R. B. Benson, 20 July, 1932, Fontainebleau Forest.

Adelpha californica, Butl.—A large part of the R.H.W. and a much smaller part of L.H.W. torn away in the anal area. Specimen fresh. H. G. Champion, July 1915, Yosemite Valley, California.

Limenitis sibylla, L.—Symmetrical deep narrow notches at the anal angles of both H.W.s. Fresh. Coll. Dr. W. R. Parkes, 5 July, 1931, Chiddingfold, Surrey. Presented by C. de Worms.

Polygonia (*Grapta*) *c-album*, L.—Symmetrical broad gaps, the bottoms shorn nearly straight, at anal areas of both H.W.s. Fresh. Coll. Dr. W. R. Parkes, 28 July, 1930, Sidbury, S. Devon. Presented by C. de Worms.

Vanessa j-album, Bdv. and Le Con.—Both H.W.s show a considerable nick at the apical angle, larger on the left side where the anal angle of F.W. is also involved. Rather worn. A. Loveridge, who informs me that the insect was probably seeking winter quarters in his garage on the door of which it was found, 27 Sept., 1931, Dudley Road, Newton Centre, Mass., U.S.A.

The following wings were found in the garden of St. Helens Cottage, St. Helens, Isle of Wight, evidently rejected by birds which had devoured the bodies :—2 F.W.s

of *Pyrameis atalanta*, L., 20 Aug., 1932; 1 L.F.W., 2 R.F.W. of *atalanta*; 1 R.F.W. of *Vanessa io*, L.; 1 R.F.W. of ♀ *Ganoris rapae*, L.—all these near a *Buddleia* bush much frequented by butterflies, 29 Aug., 1932, E. B. P.

Ganoris (*Pieris*) *brassicae*, L., ♀—Each of the four wings shows a very distinct beak-mark, the imprint of the tip being especially clear. It is probable that the insect was seized by the outer margin of the wings when in the position of rest and thus that all the marks were made together and that a shifting of the wings at the moment of attack was the cause of the slight want of coincidence between the marks. The marks of the beak tip are well within the F.W.s cells. There is also a large gap in the outer margin of both left wings with two dentate internervular projections in each gap and a straight mark as if made by one side of a beak, along the line where the fragment has been torn away or broken off. These two gaps also appear to have been certainly caused by a single seizure when the wings were together. A fresh specimen. Dr. Nevil V. Sidgwick, F.R.S., September 1890, Keswick.

Ganoris (*Pieris*) *brassicae*, L., ♂—Fluttering on the grass in front of the Oxford University Museum. Both left wings wanting except for small fragments of the bases. The condition of the right wings shows that the specimen was fresh. A. H. Hamm, 25 May, 1929.

Ganoris (*Pieris*) *brassicae*, L., ♀—Carried and dropped by a sparrow in the garden of Emmanuel College, Cambridge. The specimen is much worn and chipped and no beak-marks could be detected with confidence. The loss of scales prevents the traces which might have been preserved. H. Worsley Wood, 8 Aug., 1931. Mr. Wood kindly gave me the following note on the observation.

" Unfortunately I did not see where the sparrow came from. It flew so near my head that I think a sudden movement of mine caused the bird to drop the *brassicae* just in front of me. I had a good view of the insect held in the beak and it was quite lively when dropped. I had the impression at the time that the insect had been picked up at rest, and I think that must have been so, as it had been raining heavily and was then very cloudy—no sun at all. I was searching for *Bryophila muralis*, Forst., at the time and 3 years' experience with this insect and *perla*, F., has convinced me that the sparrow gets far more larvae and pupae in a short time than I could over a number of years. Dr. Cockayne will confirm this, I think. 11 May, 1932. H. W. W."

Ganoris (*Pieris*) *brassicae*, L.—A butterfly believed to be undoubtedly this species seen to be captured by a Spotted Flycatcher, 2 August, 1932, at Haredene, Albury Heath, nr. Guildford. The butterfly was a poor flier, and three minutes later the bird chased another with strong flight and missed it. Mr. Champion B. Russell and one other observer were under the impression that the butterfly was swallowed, wings and all. No wings were seen falling, nor anything white seen in the beak as the bird flew to its observation post. On 16 August the exhibited R.F.W. and L.H.W. of a ♀ *brassicae* were found by Miss Norah Bruce under another of the Flycatcher's favourite posts, but different from the one mentioned above.

Pieris napi, L., ♂—R.H.W., beak-mark from the costa (where the R.F.W. is also marked) with tip in cell. L.H.W., beak-mark from direction of apical angle, tip near anal angle; a second from direction of base, tip on outer margin, the two bases superposed in and beyond end of cell. L.F.W., beak-mark from direction of

anal angle, crossing cell with tip slightly beyond costa. R.F.W., short irregular marks near costa and crossing cell. Apart from these marks, condition fresh. Dr. R. C. L. Perkins, D.Sc., F.R.S., 23 July, 1932, Bovey, Devon.

Anthocaris cardamines, L., ♂—L.F.W., long narrow beak-mark entering costa at the orange patch, crossing wing with tip just invading the L.H.W. costa; L.H.W., large gap in outer margin with 2 small beak-marks entering near anal angle and a third entering from the inner margin. Fresh. Evidently attacked on the L. side when wings were open. Dr. R. C. L. Perkins, 9 May, 1932, Newton Abbot.

Gonepteryx cleopatra, L., ♂—Symmetrical injury near the anal angle of hind-wings; the specimen fresh. W. Fassnidge, F.E.S., 1 Sept., 1930, Digne, Basses Alpes, France.

Nemeobius lucina, L.—A very distinct, broad beak-mark entering the R.F.W. costa near the base, extending into and nearly crossing the R.H.W. which bears the tip-mark. Evidently seized from the front when the wings were open. The specimen is otherwise uninjured. G. H. Conquest, 24 May, 1876, Barnwell Wold, Northants. Mr. W. Rait-Smith, who presented the specimen, informs me that it was bought at the Stevens sale of the Conquest collection, many years ago.

Parnassius apollo, L.—The L.H.W. torn away except for a small basal fragment which could not have aided flight in any way. Fresh. The history of this interesting specimen is recorded in the following letter from Mr. W. Parkinson Curtis, the donor :—

" I saved the enclosed for you. It was taken at Maurin in the Valley of the Ubaye, Basses Alpes, at 8500 ft., either 3 or 4 Aug., 1932. The insect came down in a hurry for about 400 ft. and settled in the flowers on the edge of the Ubaye. The flight was unsteady and vacillating but not slow. I put my net over it and boxed it, and then to my chagrin found it in this damaged state. As you know *apollo* is a very restless insect and with its uncertain flight covers a long distance either horizontally or vertically or both in a very short time, especially if the sun is really hot, as it was. (The species is very positively thermotropic.) It does not usually settle in the grass except when the sun is clouded, though it feeds at flowers of low-growing plants, especially *Sedum acre*, etc. I want you to observe the type of damage and to note that the specimen is fresh. As a matter of fact *apollo*, at that elevation and in a late season, was only just emerging. Amongst the possible explanations is this :—a Red-backed Shrike (*Lanius collurio*) was nesting and hawking in the exact direction from which the *apollo* came, but I was busy collecting and did not see the bird make an attack on any insect."

The contrast between the Geometrid moths *Eupithecia albipunctata*, Haw., and *E. trisignaria*, Herr.-Sch., in the production of dark forms and the liability to the attacks of parasites, in the neighbourhood of Repton, by H. C. Hayward, M.A., F.E.S.

Prof. Poulton, in the absence of his friend, the author, communicated the following interesting notes, and exhibited the specimens to which reference had been made.

" The larvae of both these Eupithecias occur at the same time—September and October—on *Angelica*. In captivity *albipunctata* appears in April and is readily

forced out in February or March; *trisignaria* appears in June and in my experience completely resists forcing. Those I tried to force this year with damp heat emerged at the same time as the rest.

"*E. albipunctata* is more than decimated by parasites. Besides the two now sent it is attacked by a minute gregarious species, probably a Chalcid, which leaves nothing of the dead larva except the distorted and distended skin, enclosing a mass of parasites. In my experience, and in this neighbourhood, one can hardly expect to breed imagines from more than about 25–30% of captured larvae. *E. trisignaria*, on the other hand, seems almost completely immune, though the larvae are of the same size, on the same plants, at the same time. In fact the specimen I send is the *only* one I have ever bred from this species, and I have never known a *trisignaria* larva attacked by the small gregarious parasite. As a natural result *albipunctata* is becoming scarcer and *trisignaria* commoner year by year in this locality. When I first turned my attention to the two species about twenty years ago, *albipunctata* larvae outnumbered the others by more than ten to one. If anything, *trisignaria* is now the commoner of the two, and from several once well-tenanted localities *albipunctata* seems to have entirely disappeared.

"The black form of *albipunctata*, the var. *angelicata*, Barret, now seems to occur almost as commonly as the type; twenty years ago it was decidedly rare, probably not more than 5% or 10% of the larvae producing it. Perhaps, now that it has started, the parallel form of *trisignaria* may in course of time become equally common. The example included in the exhibited series will be seen to be hardly distinguishable from *angelicata*. It is, I think, of some rarity, and I believe still unnamed. I have myself bred only three specimens, two of them this year, and I have not seen it or heard of it from any other locality; but I am glad to send you one, so that it may be represented in a large accessible collection.

"I have bred numbers of the small gregarious parasite or a closely allied species from other Eupitheciid larvae, notably *succentauriata* and *subfulvata*, but have not preserved any of them.

"All the pupae from which the exhibited series was bred were from collected wild larvae, the majority of them from the swampy outskirts of a large wood known as Repton Shrubs, once the happy hunting-ground of several well-known entomologists, amongst them George Baker, Dr. Mason of Burton, and W. G. Sheldon. *E. trisignaria* I have found only there and in some neighbouring spinneys, *albipunctata* sparingly wherever *angelica sylvestris* flourishes. Both larvae have been reasonably common here this year. I am collecting a fair number, and, if you wish, I will report to you how they turn out and whether the *trisignaria* pupae again produce any melanic forms. (See 1924, *Proc. Derbysh. Archaeolog. & Nat. Hist. Soc.*, New Ser., I, pt. 1 : 127, for my experience of the two species in 1922–23.)"

The two Ichneumonidae from *albipunctata* had been kindly determined by Dr. C. Ferrière as *Platylabus pumileo*, Holmgr., ♀ (Ichneumoninae), and *Pimpla brevicornis*, Grav., ♀ (Pimplinae); the single Ichneumonid from *trisignaria*, as *Triclistus pallidipes*, Holmgr., ♀ (Tryphoeninae).

Mr. Hayward had written 16 November, 1932, giving the following additional information concerning the recently collected *Eupithecia* larvae.

"I collected a number of specimens of the larvae of these two species this autumn and the result to date may be of interest. I kept the two species distinct and took of *albipunctata* 132 larvae in all and of *trisignaria* 102. Judging by earlier years I thought this would give me perhaps 50 or 60 pupae of *albipunctata*, perhaps less, but nearly 100 of *trisignaria*. The results were startlingly different. Of *albipunctata* I obtained 93 pupae, only 13 larvae having been destroyed by the gregarious parasite that in some years is so much more destructive to this species. I imagine the other parasites which mature in the pupae will be present, but that one does not know till the spring. Of *trisignaria* I found only 27 pupae, and one larva with the gregarious parasite. I found about a dozen dead and shrivelled larvae and can only suppose that they died from some disease, not parasitic. I had noticed that some of the collected larvae did not seem to be very healthy. I also found that the fibre in which they had gone down contained larvae of *pseudospretella*, and it is possible that these claimed some victims."

Dr. E. A. Cockayne said that he had taken many larvae of both *Eupithecia albipunctata* and *trisignaria* in Surrey. *E. trisignaria* in his experience occurred only on *Pastinaca sativa*, which grows chiefly on the chalk and seldom in wet places, while *albipunctata* fed, as a rule, on *Angelica*, which prefers wet ground. In Scotland, where *Pastinaca* is not a native *trisignaria* must feed on some other food, probably *Angelica*. He had bred no parasites from larvae of *trisignaria* and not many from those of *albipunctata*. The latter kept in the house emerged in February and March, but *trisignaria* could not be forced in this way.

Notes on some migratory butterflies.

Dr. C. B. Williams exhibited specimens of the following migratory butterflies :—

Catopsilia florella and *Terias senegalensis* captured in January 1928 at Amani, Tanganyika, migrating in opposite directions throughout the whole month.

Belenois mesentina and *B. severina* taken during migration at Londiani, Kenya, in April 1932 by Mr. R. Graham. The flight was apparently almost continuous during the month, yet specimens captured on 11th April were all *B. mesentina* and those on the 17th April were all *B. severina*.

Pieris rapae captured during a migratory flight to the west at Harpenden, England, in August 1932.

DISCUSSION.

The law of Priority in Nomenclature.

Professor F. Balfour-Browne in opening the discussion said :—

The International Commission on Zoological Nomenclature is a long-established body, having been in existence for about 30 years, and amongst the things that it has accomplished has been the general adoption by Zoologists of all nations of the rule of priority in nomenclature, the rule being to the effect that "the valid name of a genus or of a species can only be that under which it was first described."

By the application of this rule, nomenclature has undoubtedly been simplified up to a certain point, but it has been evident for some time and even to the Commission that, so far as past literature is concerned, the rule has served its purpose

and is now creating more difficulties than it is solving, removing well-known names round which a literature has grown up and even in some cases requiring the exchange of names between species. Even the Commission was aware of the senility of the rule since it set up the proposal for conserving well-known names regardless of the law of priority.

It has been recognised on all sides that the principle of the creation of "*nomina conservanda*" was a good one, but the method of establishing them, as laid down by the Commission, is so long and tedious that very little has been done in the matter. Not only is it a long and tedious matter to get a name conserved, but most of us do not know whether lists of *nomina conservanda* exist and, if so, where they are to be found, and I feel therefore that in this part of its work the Commission has entirely failed. This failure is chiefly due to the cumbersomeness of the Commission, the impossibility of its holding frequent meetings, and also to the fact that the Commission relies largely upon the private individual who is sufficiently keen to bring matters before it and who has probably died before the Commission has decided what to do with his communication. I do not believe that the practical side of the work can be carried out on so large a basis as international agreement.

In 1912, it seemed as if this point had been recognised, as, at the International Congress of Entomology at Oxford, a British National Committee on Entomological Nomenclature was set up "to consider what elucidations, extensions and emendations, if any, are required to the International Code." This Committee, beyond printing a series of rules for Entomological nomenclature with which, in general no one wishes to disagree, has done nothing more than the International Commission in clearing up the difficulties which continue to accumulate because of the unintelligent application of the rule of priority.

Again I attribute the failure of this Committee to the fact that, although a British Committee, it has been tied to an International Congress and is therefore powerless to do anything at a speed which can produce useful results.

I therefore suggest that we, in this country, take the matter into our own hands and decide that, *so far as past literature is concerned*, the rule of priority is, possibly with certain reservations, to cease to apply and that the names by which we now know species are to be declared to be "*nomina conservanda*" without all the elaborate formalities attached to the process by the International Commission.

I suggest that, so far as Entomology is concerned, an Entomological Committee be appointed with power to appoint a number of sub-Committees on different Orders of Insects or even on groups within Orders, the main work of the parent Committee being to correlate and approve the work of the sub-Committees.

Everyone who has tried to identify species from descriptions has recognised the inadequacy of description alone, and therefore I propose that in our National Collections, if the actual type of a species is not available, an equivalent of a type be set up so that in this country we shall have specimens regarded by the best available authorities as representing the species as it was first described. Such type representatives or "neotype" specimens would be designated in the ordinary way with generic and specific names followed by the signature of the describer and, in brackets, a signature representing this country and the year in which the "neotype" was set up. Thus, *Dytiscus marginalis*, L. (London 1932).

It has been proved by the failure in later years of the International Commission

that this matter cannot be carried through internationally, and my suggestion is that we begin at the other end and show the Zoologists of other nations that it is possible to get on with things by beginning in a small way and extending the system. If this works out, as I feel that it will do, it will undoubtedly be taken up by other countries where, in due course, similar "neotypes" will be set up, with Paris, Berlin, Washington, etc., as the bracketed signature. In those cases, comparatively few, where countries had differed as to the identity of a species, the bracketed signature would be sufficient distinction. If, for instance, the French entomologists differed as to the identity of the Linnean *Dytiscus marginalis*, it would very quickly be known that *D. marginalis*, L. (London 1932) was a different species from *D. marginalis*, L. (Paris 1932). In most such cases there is little doubt but that agreement would soon be reached and *D. marginalis*, L. (Paris 1933) might be the result.

This example will indicate to you that, in my opinion, even *nomina conservanda* should not be irrevocable if common sense shows that a change is towards general agreement.

In bringing this matter before the Entomological Society, I am quite aware that it is a proposal which, if it leads to any organised action, will require moulding into shape, but I believe that in it lies the solution of some of our chief difficulties in nomenclature.

I am therefore hoping that those of you who think the scheme worthy of further consideration will discuss the scheme rather than the details, the scheme being that, so far as past literature is concerned, the rule of priority is to cease to operate and we are to set about making extensive lists of "*nomina conservanda*" as quickly as possible.

Further, we require some ready means of identifying species whose names we conserve, and "neotypes" should therefore be set up in the National Collections. If the result of the discussion is that this Society nominates an Entomological Committee to consider ways and means, I propose to carry the matter a stage further by suggesting to the Council of the Association of British Zoologists that the subject be discussed at the Annual Meeting of that Association in January, and, if the Annual Meeting is favourable, the Council would no doubt set up a Committee which would work with the Committee of this Society in clearing up and simplifying Zoological nomenclature for British Zoologists.

Let me, in conclusion, emphasise the importance to all of us of a simplification of the system of nomenclature, the avoidance as far as possible of rules and a general plasticity of the system to suit all the different branches and even the sub-branches of Zoology. Hitherto, the framing of rules seems to have been the obsession of both the International Commission and of the British Committee on Nomenclature.

Dr. F. A. Bather, F.R.S. (a visitor), speaking as a member of the International Commission on Zoological Nomenclature, said that the Commission had for some time favoured the establishment of small committees to investigate the nomenclature of particular groups and to draw up lists of *nomina conservanda*. But, in spite of Prof. Balfour-Browne's apparent distinction between Entomologists and Zoologists, it must be remembered that they were all subject to the same System, and, so long as that was the case, it was necessary that the ultimate decision should lie with an International body dealing with all classes of animals. If Entomologists

or Ornithologists or any other specialists went their own way, there was likely to be duplication of names. Even within a single group, or a single country, it was not likely that all were using the same names for the same species, so that it was impossible to cry "Halt" and fix the *status quo*. As for "common sense," it generally meant an individual view (*quot homines*): there was no such thing as "common" sense. Hence the necessity for control by an overriding International Commission. The Commission had to move slowly or it would wreck the train.

The idea of setting up standard specimens in the different national museums was good, but such specimens could derive authenticity only from the original author or from an expert who had compared them with the actual type. Any worker could be intelligible to his colleagues, whatever name he used, provided that he gave a definite reference to either a standard monograph or a standard specimen. That, however, could only be provisional, and the great need of systematic zoology was not the constant description of new species but the more difficult work of interpreting and fixing the old names. If in the past very few insect names had been considered by the International Commission, that was simply because the Entomologists had made so few proposals. They all desired fixity, and the Commission would welcome any help that British Entomologists could give to that end.

Dr. Hugh Scott, without pronouncing for or against the details of Professor Balfour-Browne's scheme at this stage, wished strongly to support Professor Balfour-Browne in his effort to get the whole position reconsidered. He also desired to see a considerable extension of the principle of making *nomina conservanda*, and the decreeing of much longer lists in almost every group. He strongly deprecated the practice of suppressing familiar names, which have been long in use, and under which much important information is recorded in zoological literature, in favour of older names which are forgotten, which are frequently coupled with quite inadequate descriptions of the species concerned, and under which no information of moment is recorded. When two or more names are in use for one species, the question must be decided, either by applying the law of priority, or by making one of the names *nomen conservandum*. But why must old forgotten names be resurrected, when there is no dispute as to the one name in common use?

Dr. Karl Jordan, referring to the question of nomenclature raised by Professor Balfour-Browne, said that the inconveniences caused by the strict application of the rule of priority had been discussed at length during the 9th Zoological Congress at Monaco in 1913. Strong arguments were advanced on that occasion for and against strict priority; in spite of the clash of opinions both sides sensibly agreed in the end on a compromise to the effect that the Commission on Zoological Nomenclature was empowered to suspend the Rules in cases where their strict application would lead to greater confusion than uniformity. The decision about such cases would rest with the Commission, which, however, would be guided by the specialists working in the group of animals in which a case arose. This policy of consulting specialists had been carried out wherever there were specialists willing to co-operate with each other and with the Commission. The procedure was certainly a slow one, as the Secretary of the Commission had to place each case before the eighteen Commissioners distributed over the globe. A decision could be expedited if there were numerous Committees each dealing with the names of a restricted group of animals after having consulted the specialists in that group.

The difficulties encountered in organising such Committees was great, as specialists frequently held strong opinions and were unwilling to obey adverse majority decisions. There was a National Committee for Entomological Nomenclature in several countries, but only the British one had done considerable work, British Entomology having the great advantage that a large number of active, broad-minded and willing workers lived in, or in easy reach of, London. The National Committees were under an International one, the Commission acting as a Court of Appeal. If decisions were left to each National Committee or to each Committee of specialists without any central control, chaos might result. If cases of hardship, or lists of *nomina conservanda* were placed before the Commission, the wishes of the specialists and University teachers would have great weight with the Commissioners.

Brigadier W. H. Evans said that he spoke as an ordinary Butterfly Collector, to which class the frequent changes in nomenclature were intensely irritating. When he began collecting the common Small Copper butterfly was known as *Chrysophanus phlaeas*; then it became *Heodes phlaeas* and later *Lycaena phlaeas*. He entirely agreed with all that Professor Balfour-Browne had said. He considered that anyone should be able to ascertain from the British Museum what the correct name for a species was; that some central authority such as the British Museum should issue lists indicating the names accepted by them. He admitted the necessity for rules, but it was for the central authority to deal with such rules and with higher organisations such as the International Commission. Lists as indicated would be accepted by the whole Empire. Protection would also be ensured against ill-considered publications containing changes: it would be up to the central authority to accept or reject any proposed changes.

Sir Guy Marshall and the Rev. Miles Moss also took part in the discussion, and it was agreed that the matter be referred to the Council of the Society.

Wednesday, December 7th, 1932.

Dr. H. Eltringham, President, in the Chair.

The Secretary read for the second time the nominations of the Council for Officers and Council for 1933.

Obituary.

The death of Mr. T. H. Taylor, a Fellow of the Society, was announced.

DISCUSSION.

Protective adaptations of animals—especially insects.

In the unavoidable absence of Prof. Poulton the substance of his remarks, which are reproduced in full below, was communicated by Dr. G. D. Hale Carpenter, who said that it seemed to him that McAtee's method of proving the uselessness of Protective Adaptations was as if one "proved" that steel helmets were no protection against head wounds because out of X number of corpses Y had received fatal bullet wounds through the helmet (1932, *Trans. Ent. Soc. Lond.*, **80**: 371).

Prof. E. B. Poulton, F.R.S.

[To my great regret I was unable to be present on December 7 and take part in the discussion. I wish to express my warm thanks to my friend Dr. G. D. Hale Carpenter for giving an account of the subjects on which I had hoped to speak and for showing the slides intended to illustrate them.]

It is obvious that, in the necessary limitations imposed by the conditions of a discussion, it will only be possible to reply to a very few of the statements and opinions published in Dr. W. L. McAtee's lengthy papers which appeared in 1912 * and 1932.† I hope, however, by bringing forward certain communications, to appear on later pages in the *Proceedings* of this date, to direct attention to observations which bear upon Dr. McAtee's conclusions, and this without overweighting the discussion.

I propose therefore, in these remarks, to speak chiefly upon Dr. McAtee's main contentions—" that availability undoubtedly is the chief factor involved in the choice of food," and " that the phenomena classed by theorists as protective adaptations have little or no effectiveness " (1932 : p. 144). The conclusions of his earlier paper (1912 : p. 364) that the results of experimental feeding " do not indicate the part the animal might play in natural selection " and that their value in determining " the efficiency of warning colors, and other protective adaptations of prey, is very questionable," were shown to be unsound in a paper read before the Fifth International Entomological Congress in Paris last July, to be published in its Proceedings. Further confirmatory evidence will appear in later pages.

Instinctive " Availability."

In recent years our *Proceedings* have published references to older observations, and have recorded fresh observations on " availability " intensified by the instinct to collect in sleeping assemblies, displayed by species of the conspicuous groups which provide the chief models for mimicry by other diurnal Lepidoptera in the tropics of all parts of the world. I would here like to add to these numerous examples another of great interest brought to my notice by my friends Mr. A. Hall and Mr. C. H. Lankester, viz. Miss Marianne North's painting at Kew of *Heliconius erato phyllis*, F., assembled for the night. Being unable to visit the North Gallery at the Royal Botanic Gardens, before the meeting of 7 December, I wrote to my friend Sir Arthur Hill, who very kindly replied, 19 November, 1932 :—

" I have just been to the North Gallery and looked at Miss North's landscape with the *Heliconius*. The picture gives the impression of fairly bright daylight, but there is an idea of an evening glow in the sky. All the butterflies except one are attached to the stem of the plant with their wings closed, but one is shown with wings fully expanded. The only description of the picture that we have is in the Official Guide to the North Gallery (6th ed., 1914, p. 10), which reads as follows :—

* " The Experimental Method of Testing the Efficiency of Warning and Cryptic Coloration in Protecting Animals from their Enemies." *Proc. Acad. Nat. Sci. Philadelphia*, June, 1912, pp. 281–364. (Issued 6 Sept., 1912.) To be quoted as " 1912 : " followed by the page or pages.

† " Effectiveness in Nature of the So-called Protective Adaptations in the Animal Kingdom, chiefly as illustrated by the Food Habits of Nearctic Birds." *Smithson. Misc. Coll.*, **85**, No. 7 : 1–201. (Published 15 Mar., 1932.) To be quoted as " 1932 : " followed by the page or pages.

" '50. **Landscape at Morro Velho, Brazil.**—In the foreground is a colony of Butterflies (*Heliconius phyllis*) going to roost on a single segment of a palm leaf, from which they will never move until the sun's rays reach them in the morning. This insect has a powerful musk-like scent by which the artist often found her way to it.'

" Miss North reached Brazil on August 28th, 1872, and appears to have remained in the country about a year. She was at Morro Velho in January 1873 and apparently some time before and after."

No reference to the painting is to be found in Miss North's two books,* but the above-quoted statement from the Official Guide, obviously written by her or from information supplied by her, and recording observations made sixty years ago, gives in a condensed form one of the best accounts of the assembling and dispersal of a Heliconine sleeping association that appeared before the publication in 1930 of Dr. F. Morton Jones's description of the habits of *Heliconius charithonia*, L., in Florida.†

A great deal more might be said about the " availability " of conspicuous gregarious insects, but I will only mention the Burnet moths (ZYGAENIDAE) known to every young collector, found year after year ‡ in open grassland, often crowded in a corner of a field or common—conspicuous in flight or at rest, sluggish, their white cocoons displayed high up on grass-stems. Who except Dr. McAtee, and possibly Mr. Uvarov and Prof. MacBride, can doubt that some quality possessed by these conspicuous insects prevents the attacks of many enemies—I do not say all—and enables the colonies to continue? How different would be the fate of procryptically coloured insects crowded in a small area—a difference which was brought to my notice with tragic results, as will be described in the following section.

Controlled or Artificial " Availability."

From 1917 up to and including 1932 I have conducted breeding experiments on *Abraxas grossulariata*, L., the larvae after the first two years being always sleeved in muslin bags on the food-plant—*Prunus pissardii* almost from the first. Many bags, generally many dozen, exposed in this way during each of these years, were not attacked by birds, and the larvae—proved to be distasteful by many recorded experiments, considered to be valueless by Dr. McAtee—suffered very rarely, and then only from enemies accidentally enclosed with them. Thus on one occasion 48 earwigs, all full-grown except 6, were found in a bag which not unnaturally contained, out of 12 larvae, only a single one and that moribund. What a contrast was afforded by breeding experiments in 1919 on the procryptic stick-like caterpillars of *Amphidasys betularia*, L., which were also sleeved on the food-plants,

* *Recollections of a Happy Life, being the Autobiography of Marianne North*, London (Macmillan), 1892, 2 vols. 8vo, and *Some further Recollections of a Happy Life, etc.*, London (Macmillan), 1893, 1 vol. 8vo.

† 1930, *Nat. Hist., J. Amer. Mus. Nat. Hist.*, **30** : 635. Abstract with references to other records, in 1931, *Proc. Ent. Soc. Lond.*, **6** : 4–10.

‡ Two small colonies of *Anthrocera* (*Zygaena*) *trifolii*, Esp., about 200 yards apart, and each occupying about 15 square yards were observed on E. Dartmoor by Dr. R. C. L. Perkins, F.R.S., for 4 out of the 5 years ending in 1914. " One very windy day several specimens were made to fly, but in each case they returned against the wind to the starting-place." The two colonies were distinguished by variational differences (*Proc. Ent. Soc. Lond.*, **1914** : xcv, xcvi; see also 1915–16, *Proc. Linn. Soc. Lond.*, Session **128** : 23, 24).

principally poplar and pear. Unhappily, but usefully for the strengthening of those weak Darwinians who are impressed by Dr. McAtee's confident assertions, both the birds and the wasps discovered these only too "available" larvae and, after that, no more could be bred in the open. On one occasion I saw an enemy, a Great Tit, at work, dragging an unfortunate caterpillar out of the hole it had made, and wasps were often found in the bags, two or three together, while the blackened remains of mangled larvae on the outside bore witness to their activities. As soon as these enemies discovered the supply, the method had to be modified. An attempt to protect the larvae by enclosing one bag inside another was a failure and finally it became necessary to continue the experiment in a closed building. Who can believe that the birds

Fig. 1.—Under surface of 3 specimens of *Phlogophora meticulosa* rejected by Long-eared Bat after devouring a part or the whole of the thorax.

which made and exploited this discovery were not aware of the *grossulariata* in their bags in the same garden, or the dark colonies of Small Tortoiseshell larvae freely exposed on the nettle-beds on the other side of the road—I am referring to experiences at St. Helens, Isle of Wight—or the clusters of Buff-tip caterpillars advertising their presence by the conspicuousness of their massed colours, and also by the expanse of leafless twigs around them? *

The Preferences of the Enemies of Insects.

During the past summer I have come across some curious and unexpected evidence of food preference in the Long-eared Bat. The general avoidance of highly conspicuous moths has been clearly shown in the recorded 1330 specimens

* These larvae "are readily found by the devastation they cause: each brood fixes on some topmost outside branch . . . and, completely stripping off the foliage, leaves the twigs as bare as in the depth of winter" (Edward Newman in *British Moths*, Lond., 1869, p. 220).

named from their rejected wings, all but 16 of these being typically procryptic forms.* The inquiry has been continued, with the help of many friends, until October of the present year and an immense amount of confirmatory evidence collected. I have been surprised to find that the Long-eared Bat commonly rejects the abdomen of certain moths such as *Triphaena pronuba*, L., *Xylophasia monoglypha*, Hufn., and *Phlogophora meticulosa*, L. Thus the rejecta of 36 examples of this latter species, dropped by the Long-ear in the verandah and porch of St. Helens Cottage, St. Helens, Isle of Wight, between 27 June and 12 September, 1932, included no less than 11 abdomens. The rejecta of three specimens are shown from the under surface in the accompanying Fig. 1. The head, which is never eaten, was evidently blown away from the remains of one specimen. A "very windy night" was noted on the label. The thorax and anterior portion of the abdomen of one specimen have been eaten, but only the thorax, wholly or in part, of the two others. It is obvious that the economic significance of the bat is greatly increased by its fastidious tastes, which became especially evident when there was a plentiful supply of moths.

A somewhat similar observation was made last July in Paris, where the wings of the Satin Moth (*Stilpnotia salicis*, L.) were scattered over the ground below the Black Italian Poplars on both banks of the Seine. Experiments have shown that these moths are highly distasteful, at any rate to the marmoset,† yet they had evidently been freely attacked in Paris—a probable consequence of the relative scarcity of insect food in a great city. My friend Mr. Champion Russell has also observed the specially clever capture of moths by London sparrows.‡ It was of much interest to find that in Paris, parts of the body, such as the abdomen or fragments of the thorax were sometimes rejected and found lying on the ground, either attached to other parts or separate. Save in one instance of an evident beak-mark, it was impossible to determine, from the examination of the wings collected and exhibited to the meeting, whether birds, bats, or other enemies had been at work.

On the subject of white moths, a recent observation,§ brought to my notice by

* *Proc. Zool. Soc. Lond.*, **1929** (2) : 284, 285.

† Poulton, *Colours of Animals*, London, 1890, pp. 241–43. See also 1871–72, *Ent. Mon. Mag.*, **8** : 206, 207, for an account of the excessive abundance of this moth at Sheerness in 1870, and an experiment which showed that the larva, as also that of *neustria*, *auriflua* and *chrysorrhoea* were rejected by a tame starling. I owe this reference to a note by the late Gervase F. Mathew to my friend Commander J. J. Walker.

The 3 examples of *salicis* tested by Dr. F. Morton Jones showed a rating of 57·3, and thus but little higher than the average (55·4) of the 28 white moths—an average which the author suggests, making allowance for the small number, may be considered as "an indication of a slowing-up in acceptability." 1932, *Trans. Ent. Soc. Lond.*, **80** : 354.

‡ 1932, *Proc. Ent. Soc. Lond.*, **7** : 10.

§ The following note by Harold O'Byrne, of Webster Groves, Missouri, appears in 1932, *The Canadian Entomologist*, **64** : 239 :—

"On July 6, 1932, I observed a female of *Diacrisia virginica*, Fab. [Arctiinae], resting on an inside wall of a large building in St. Louis, Missouri, where it probably had alighted the night before. At 6.35 p.m. (Central Standard Time) it suddenly took flight, passing out of the building through a wide doorway. An English sparrow nearby saw the moth and started in pursuit; the moth flew to the ground, but resumed flight when the bird alighted beside it. The sparrow followed the moth and caught it in the air with its beak. It carried the moth to the ground some thirty feet away and dropped it there. Then the bird gave it an investigating peck or two, and then stopped. After standing guard over the moth for a few minutes, and then chasing away another sparrow that approached, the bird presently flew away itself. I picked up the moth, which began to struggle for freedom, and I saw that it was uninjured except for a badly torn hind-wing. When I placed it in a small box, ovipositing began at once; more than 500 eggs were laid, which subsequently hatched.

two of my friends, may be quoted as an example which harmonises with the results of experiments on *S. salicis* (p. 83 and note).

The complex inter-related adaptations which combine to render possible the protective value of colour, pattern, and form.

I have commented elsewhere * on Dr. McAtee's criticism of the belief that the stick-like caterpillars of Geometrid moths are " protected by resemblance to twigs, etc., a statement made without giving due weight to the fact that such a defense depends upon immobility, whereas these caterpillars must be in motion the greater part of the time while searching for and devouring food" (1932 : p. 58). The fact that they are thus in motion *at night* and maintain the rigid stick-like attitude by day is evidently unknown to Dr. McAtee, as also the adaptations which enable them to preserve their immobility. But the number and variety of these adaptations and their correlation with the appearance and habits of the larvae at different stages of growth immensely increase the probability—to many it will seem the certainty—that the harmonious result has been directed to a single end—that of concealment by day—by the operation of natural selection.†

First then, the stick-like diurnal attitude necessitates the susceptibility to stimuli which determine its assumption at dawn and termination in the evening—between 9.0 and 10.0 p.m. in the larva of *Ourapteryx sambucaria*, L. (*Proc.* : **1919 :** xxxiv)—when the caterpillar begins to feed. The adjustment of the larval resemblance to the part of the food-plant which it seeks for the diurnal position has been proved in many species to be brought about by special susceptibility to a stimulus (reflected light) emanating from the food-plant itself, the susceptibility being such that the larva will be well concealed on any one of the different food-plants selected by the parent for oviposition (**1892 :** 304–360, pl. xiv, pl. xv, figs. 1–4; **1903 :** 311–74, pls. xvi, xvii, xviii).

Then again, the stick-like attitude would not be appropriate and is not assumed in all stages of the life of a Geometrid larva, as has been shown in those species which have been studied from this point of view. When they are young and much too slender to represent a side twig of the food-plant, they remain upon the leaves by day, assuming irregular or somewhat spiral attitudes, some species hanging head downwards from the edge like a twisted brown fragment of leaf,

" Contrary to the opinion often expressed by proponents as well as adversaries of the various theories on protective adaptations, this occurrence shows that attacks by birds upon insects, even when they are as soft and delicate as this moth, need not necessarily be fatal. It shows, too, that birds may have ample opportunity to discover any disagreeable quality that may make an insect an unsatisfactory morsel of food, without seriously injuring it. Whether this particular species is so protected I do not know, but the action of the sparrow in catching the moth and then deserting it appears significant."

My friend Dr. F. Morton Jones, when kindly giving me this reference, wrote 8 Nov., 1932 :—

" I'm sorry the snow-white *Diacrisia virginica*, in the five times I employed it, did not earn a lower acceptability rating, in line with this observation; but in my paragraph [*ibid.*, p. 354] on white insects in general, you will recall that they seemed to exhibit a slowing down of acceptability. Perhaps with more experiments with this particular species, my early results would be modified."

* In a paper read at the meeting of the Fifth Internat. Entom. Congress, July 1932, and to appear in the Congress Proceedings.

† Many of these adaptations have been described in our *Transactions* and, in referring to them, it will be sufficient, in this section, to quote the year and page, also the plate and figure when illustrations have been given. Publication in the *Proceedings* will be indicated by " *Proc.* : " followed by year and page, also after 1925, by the volume.

others remaining on the upper surface and resembling, when very small, the excreta of snails, when older those of birds (**1884 :** 38–43; **1885 :** 309–318; **1887 :** 291). The wide difference in appearance between the young and the old caterpillar may be entirely due to attitude. Thus, in *Selenia bilunaria* (*illunaria*), Esp., " with a similar colouring and structure the appearance of a larva in the third stage at rest is extremely different from one in the fourth or fifth stage, and the difference is correlated with a position upon leaves or branches respectively" (**1885 :** 318 : compare figs. 17 and 18, pl. vii).

Again, the rigid stick-like attitude can only be maintained for many hours by the aid of special adaptations which may be of very different kinds but always promote the same end. The commonest of these is a thread of silk extending from the branch to the larva's head, which is uppermost and, with the anterior segments, modified to resemble the end of a side-shoot or lateral spur, the posterior

Fig. 2.—Young larva of *Boarmia roboraria* on the tip of an oak twig, and reducing the gravitational strain to a minimum by the upright position. × 2. From a drawing by P. J. Bayzand.

end and two pairs of claspers resembling the junction with the main stem. (The silken support is also sometimes necessary in the irregular attitude assumed on the surface of a leaf, *e.g.* in the earlier as well as the later stage of *bilunaria* shown in the figures referred to above, although, unfortunately, the thread is omitted in fig. 17.) If this thread be cut the larva falls back and cannot preserve its immobility until it has spun a fresh support. Another method is adopted by *Amphidasys betularia*, the caterpillar maintaining its position by holding on to a leaf-stalk or twig with its third pair of legs (**1887 :** 291, 292, pl. x, fig. 4). A beautiful modification, with a reversed position, is found in *Cabera exanthemata*, Scop., where the head and true legs clasping the stem, are below and represent the origin of a green twig or leaf-stalk, while the posterior end of the larva with the two claspers holding another leaf-stalk or twig are uppermost (1928, *Proc.*, **3 :** 32).

The simplest and most interesting adaptation is, however, that adopted by the larva of *Boarmia roboraria*, L., at the stage represented in the accompanying Fig. 2, reproduced from a beautiful drawing made for me over forty years ago by

Mr. P. J. Bayzand. In this upright position the stick-like attitude could be preserved during the daylight hours without any thread or other equivalent support, but when the twig was gently moved and fixed horizontally, the strain became too great and the caterpillar was soon compelled to change its position.

The great dangers to which these twig-like larvae are exposed has been proved by the unintended experiment described on pages 81, 82, and it is interesting to compare with them certain other Geometrid caterpillars such as *Abraxas grossulariata*, moving freely and feeding by day, thus augmenting the "availability" which is advertised by their warning colours.

I am well aware that nearly all the statements in this section are familiar to entomologists, but in view of Dr. McAtee's comment it is appropriate to recall them briefly in order to point out their significance in evolution.

I have been anxious that this discussion should not be restricted to the consideration of known data, but that new information bearing on the subject should be brought forward so far as possible. I therefore asked Miss E. L. Turner if she would kindly help by bringing together any observations she could remember on the insects eaten or rejected by British birds. These, with an interesting note on the dragonfly prey by Mr. F. J. Killington, are contained in the first communication following the discussion. The second records Miss Oehlenschlaeger's experiences with insect-food offered to young Purple Martins, near Milwaukee.

The third communication arose out of the perusal of two papers by the late Prof. F. E. L. Beal—papers to which presumably Dr. McAtee paid much attention. It is therefore of interest to inquire how far he allows weight to the author's opinion that certain Californian birds prefer and deliberately seek some insects, and avoid others which they have every opportunity of taking; also how far he estimates the occasional presence of an insect in the stomach of a bird which, according to Prof. Beal, habitually neglects the species, as evidence equal in value to the presence of large numbers in the stomach of a bird which, according to the same eminent ornithologist, habitually preys upon it. The opportunity of studying these questions and of forming an opinion upon the trustworthiness of Dr. McAtee's system of tabulation is afforded by this third and last communication, following the discussion.

B. P. Uvarov.

I recommend McAtee's paper to the attention of all biologists, because, in my opinion, it contains a mass of valuable facts which tend to challenge the adopted doctrines of the theory of adaptations as evolved by natural selection. It is particularly important that McAtee's paper is based on the examination of an exceedingly abundant material and represents an attempt to approach the problem statistically, though the statistics are admittedly only approximate. We have, on one side, a large amount of disjointed subjective observations, which have been made mainly under unnatural conditions, and appear to support the selection theory; on the other side, in McAtee's paper, we have a unique accumulation of facts relating to the food of birds, and these facts throw serious doubts on the correctness of that theory. This conflicting evidence must be faced. Even if McAtee's interpretation of the material is not accepted, the

facts accumulated by him remain and can be analysed in order to arrive at a correct understanding of the phenomenon of " protective adaptations." Simply to ignore the facts because they do not support the customary ideas would be unscientific.

Dr. R. A. Fisher, F.R.S. (a visitor).

It is excusable for a man to feel some affection for the technique of the science to which he has devoted himself, and in which he has expended some exertion in the hope of gaining some degree of proficiency. That must be my excuse if, speaking as a statistician, I show myself to be in some degree provoked or even exasperated by the paper by Dr. McAtee, which is the subject of this evening's discussion.

Three lessons have impressed themselves upon me with increasing force, during some years devoted to the application of statistical methods to biological theory and biological experimentation : Firstly, that the statistician must so far control his native arrogance as to be willing to learn from his biological colleagues the exact meaning of the particular observations which he sets himself to co-ordinate, and shall not lump together or confound heterogeneous material; secondly, that he must be prepared to adapt his methods to the material, even if this leads him, as it often will, to face the problems of new and intricate logical situations, requiring for their elucidation much new mathematical research; and, thirdly, that an integral part of his task is to study the limitations of his data, so as to make clear to himself, and to others, what it is not good for, as well as what it is. On each of these three points Dr. McAtee's paper deserves to rank as an awful warning.

The theory, which Dr. McAtee sets out to demolish, with the aid of his statistical material, may be very briefly stated. It is believed that many insects, and, of course, other animals, gain a selective advantage, either by being generally inconspicuous, or by resembling some common feature of their surroundings, and therefore passing little noticed, or by being relatively distasteful to predators, and sufficiently conspicuous to be readily recognised as such, or by resembling some other species, or group, which is really common, and to some extent avoided, without being themselves either especially numerous or especially distasteful. This theory in relation to birds, the only group upon which McAtee has evidence to offer, implies that the species showing these modifications have been for a long period in the past exposed to the depredations of birds, and, further, that the predators do not react equally to unlike objects, but are, as we say, discriminative, or selective, in their feeding habits. The theory does not imply, and cannot be conceived to imply, that any group showing protective or warning colours is immune from bird attack, for it is only by the means of such depredations that the special coloration, or other peculiarities, are believed to have been selected. The theory throws no light upon whether the depredations are less intense, equally intense, or more intense, than they have been in the past; but it does imply that the mortality of less perfectly adapted individuals has in the past been higher than that of more perfectly adapted individuals of the same species. And this, if generally true, should be true at least of the many species at the present time. McAtee's data throw absolutely no light upon *this* question.

In the case of mimetic species, where one, the mimic, has evidently been greatly modified from the appearance of its congeners, in the direction of closer resemblance

to a second species, the model, which itself has not been so greatly modified, the theory may, I think, fairly be taken to imply that during the period of modification the mimic was, for equal exposure to risk, more severely preyed upon, at least by some predators, than was the model. Data from birds' stomachs, if supplemented by very exact studies of the conditions of exposure to risk, might *possibly* throw light on this point, but from McAtee's paper we get in fact not a glimmer.

McAtee's argument, as expressed in his summary, is that " One group of predators after another is known . . . to be so largely guided in choice of food by availability as *practically* to ignore protective adaptations." This argument is reiterated later in the words : " In other words there is utilisation of animals of *practically* every kind for food *approximately* in proportion to their numbers. This means that predation takes place *much the same* as if there were no such thing as protective adaptations. And this is only another way of saying that the phenomena classed by theorists as protective adaptations have *little or no* effectiveness." Notice the choice of words in the presentation of an essentially quantitative argument, " practically," " approximately," " much the same," " little or no." Let us ask *how* largely predators must be guided in the choice of food by availability so as practically to ignore protective adaptations. I do not know within a million-fold, nor does Dr. McAtee.

When we read in the opening pages of the paper that the investigation is based upon 80,000 stomachs, and on 237,399 identifications of animals found therein, we all, I suppose, anticipated that some facts of scientific interest might be extracted from so large a body of data, even if McAtee had not been careful to tell us in a footnote that the tabulation covered nearly 1000 typewritten pages. But, if we turn to details, we find that whatever may be their value as a survey of the food-habits of American birds, the data on particular groups of insects are extraordinarily meagre. On page 56 there is a list of identifications of Lepidoptera, from which it appears that, in all, 113 butterflies were recognised, and of these 41 are unidentified, even in respect of family, so that 72 remain of which the family is known. Thus, the knowledge accumulated as to the incidence of bird attack in the Nearctic region on the whole of the PIERIDAE consists of *one* identification; * but the PAPILIONIDAE score *two*; based on which we find percentages worked to four decimal places. These 72 identifications apparently include some larvae or pupae, but it is impossible to tell how many. It should be noted that McAtee's repertoire of statistical methods seems to end with the calculation of percentages. Every count must somehow be expressed as a percentage, but it does not seem to matter what it is expressed as a percentage of. Thus in the table referred to, one column based on the number of species taxonomically described gives 90 per cent. for all moths and 10 per cent. for all butterflies, adding up, as we might hope, to 100; but the parallel column of the percentage of identifications gives 25·3 per cent. for all moths and 0·6 per cent. for all butterflies, adding to less than 26 per cent. The apparent reason is that 12,000 Lepidopterous larvae, some of which must already have been included among the moths and butterflies, though most of them must be indeterminate, have been included as a separate percentage, making 69 per cent. of the whole. I can see no use or purpose in the whole tabulation, except possibly to

* Would McAtee's conclusion be different if there were none ? or if there were 50 ?

impress people who will not go to the considerable labour of finding out what it means.

The logical structure of the central argument is sufficient alone to demonstrate its ineptitude. If a phenomenon is possibly influenced, among other things, by two factors, the least efficient way of assessing the importance of one of them is to provide data about the other. Yet McAtee really seems to believe that if he can show that predatism is influenced by availability, even without any attempt at a quantitative measure of the magnitude of this influence, it will follow that visibility and feeding preferences have no effects. By parity of reasoning, if it can be shown that entomologists are more willing to be persuaded to apply for a well-paid than for an ill-paid post, it will follow that they have adopted their occupation solely for its monetary rewards.

On two points raised by Mr. Uvarov, it would seem possible to give a definite decision. Mr. Uvarov stresses, rightly in my opinion, the necessity of considering the problem quantitatively. The difficulty arises that when a quantitative theory is developed, it is classed as mathematics, and not readily regarded as a contribution to entomological problems. Approaching the problem of selective intensity from the genetical standpoint, I have come to the conclusion that the effective selective intensity in Nature can seldom exceed 1 per cent. per generation, else evolutionary modification would be a much more rapid process than it is known to be. Probably we should think of intensities of 0·1 per cent. as more typical. On the question of the high proportion of individuals eliminated as eggs or larvae, it should be explained that however high this proportion may be, it does not in the least diminish the selective efficiency of mortality (prior to mating or oviposition) in the adult. The fallacy that selection on the adult would be " swamped " by a sufficiently high and statistically independent death rate at earlier stages, was accepted by Wallace, but will not bear critical examination.

Sir Guy Marshall, F.R.S.

Dr. McAtee's contention that his evidence from the contents of birds' stomachs has entirely disproved the Selectionist's interpretation of ant mimicry cannot be accepted. The fallacies and inaccuracies in his statistical treatment of his material have been adequately exposed by Dr. Fisher, but on the biological side also there are errors and misconceptions that vitiate the whole argument.

In the first place, negative evidence against mimicry has no value whatever if it is collected in an area in which mimicry does not occur; ant mimicry finds its highest development in the tropics, where ants are a dominating feature of insect life, but it is a comparatively rare phenomenon in the North Temperate Zone, so that negative evidence derived from North American birds must be largely discounted.

Again, Dr. McAtee tacitly assumes that all ants are supposed to be protected from attack, an assumption that is entirely without warrant. The special offensive and defensive qualities possessed by ants are their capacity to inflict a painful bite or sting, or both, or the emission of protective fluids; and even more important than these is their ability to make a combined or massed attack on anything that interferes with them. Only those who have had personal encounters with such ants as *Dorylus* in Africa, *Eciton* in Tropical America, or *Myrmecia* in Australia,

can realise how formidable these insects can be. But none of the dominant and aggressive species occur in North America, where the great majority of ants are timid and unaggressive.

Finally, it was clear that a large number of Dr. McAtee's records of birds eating ants were cases in which the winged males and females had been taken. Now these sexual forms neither bite nor sting, nor are they mimicked by other insects; their occurrence in birds' stomachs does not therefore in any way constitute evidence against ant mimicry, and the fact that Dr. McAtee has included them in his calculations makes it impossible to accept his conclusions as having any scientific validity. The material requires to be re-studied by someone who really understands what the theory of mimicry connotes.

In general, this theory is borne out by a considerable amount of experimental and observational evidence, and is supported by collateral evidence derived from the behaviour of the living insects, the toughness of unpalatable forms, etc. Moreover, it affords a logical explanation for thousands of phenomena for which no other reasonable interpretation has yet been advanced.

Mr. H. St. J. K. Donisthorpe.

I agree with Sir Guy Marshall that worker ants are in general well protected, such protection being especially brought about by the vast numbers in some colonies all ready to come to each other's assistance and overwhelm an enemy by sheer weight of numbers. They also possess other methods of offence and defence—well-developed stings, poison glands ejecting acid, and repugnatorial glands ejecting offensive discharges; unpleasant and characteristic odours; hardness of integument; defensive spines, etc.

Ants naturally have enemies—ant thrushes, woodpeckers, the ant-eaters, and ant-bears, pangolins, etc.; were it not so, ants would cover the earth. Gulls, swallows, and other birds, devour immense numbers of winged ants during their marriage flight; again were this not the case, nearly all these females would found colonies and overwhelm everything. Personally I have never seen a bird in this country capture worker ants in the field, though I have seen the long funnel-shaped holes in the nests of *Formica rufa*, L., made by the green woodpecker to get at the ants in the winter. When disturbing such nests I have often seen a robin jump down, and picking up a cocoon, fly quickly away with it; but it never picked up a worker ant.

Mrs. C. B. S. Hodson (a visitor).

The quantitative studies asked for by Mr. Uvarov were undertaken on a small scale under grants from the Government Grant Committee of the Royal Society (see Report of the British Association, **1898**: 906–909). The work was carried out on highly protected species in the pupal stage, under contrasted conditions of conspicuousness, and the survival rate would approximate to that suggested by Dr. Fisher, as was to be expected.*

* [I am very grateful to my friend Mrs. Hodson for reminding me of our work together in 1898 and later years; for the results of our experiments bear very directly upon Dr. McAtee's conclusions, as may be learned from the following rather full abstract of our communication, 13 Sept. 1898, to Section D of the British Association at Bristol—"An Experimental Enquiry into the Struggle for Existence in Certain Common Insects," by E. B. Poulton and Cora B. Sanders (*Brit. Assoc., Report*, **1898**: 906–909). The lines followed by this inquiry had been

Mrs. M. D. Brindley.

The view that the most abundant species have the most numerous enemies is not in itself very revolutionary, and many people, within limits, would be disposed to agree with it. McAtee's tables are certainly most striking, and they deal with such comparatively large numbers that it does appear as if there was at any rate a rough relation between the proportion in which a group of insects is taken by a miscellaneous bird population and the number of species recognised in that group. But I do not feel convinced that this last is necessarily a fair index of the absolute abundance in individuals of the group in nature. Professor Poulton kindly allows me to quote from a letter, sent to him by Dr. Frank Morton Jones, which bears on this point: "Dr. W. Morton Wheeler says of ants that they 'outnumber in individuals all other terrestrial animals'; yet in the New York List the FORMICIDAE constitute only a fraction of 1% of the listed genera and species. At certain seasons of the year 'grasshoppers' are the most numerous and available insect prey of many species of birds, constituting an extremely large percentage of their food; yet the genera and species of the ACRIDIIDAE number less than 1% of those enumerated for New York." To the ants and grasshoppers mentioned above, one might add the seasonal swarms of small Homoptera, and of some of the Diptera. One is struck by the fact that in the first table the only group in which the proportion taken and the abundance balance is the Coleoptera. Whatever is the reason, the Diptera are taken at less than half what their estimated abundance would suppose; Hymenoptera and Lepidoptera are also taken below the abundance level. It is stated that there was difficulty of identification in these three groups; and this might be the explanation, if it were not that the same is said of the Orthopteroidea (McAtee, 1932, p. 1) which was taken at over three times its abundance figure. The high proportion of this group suggests that the number of individuals does not bear a constant relation to the number of species, unless, as is possible, the nymphal stages of the hemimetabolous insects are more determinable in the stomach contents than the larvae and pupae of Holometabola. It is also easy when assessing the figures to overlook the fact that columns I and II deal with *identifications to family*, whereas column III, which is the index of abundance, is estimated from the number of *known species*. No one has ever denied that certain species of each of the large insect groups are preyed upon by birds. The question at issue is, which species

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suggested in 1892 (*Trans. Ent. Soc. Lond.*, **1892**: 471–77), and "we determined to concentrate our attention on the pupae of certain butterflies, this stage being especially suitable because the chrysalis is motionless, and, therefore, remains in any position in which it has been fixed until it is seized by an enemy or emerges as an imago. Our object was to decide:—(1) whether there is a struggle for existence during the pupal stage; (2) whether the struggle, if it takes place, is decided by the conspicuousness of the pupa." Of 549 pupae of *Aglais* (*Vanessa*) *urticae*, L., exposed in three different localities, 331, were taken and 218 left, of which 123 had emerged. Question (1) was answered with certainty "as regards those localities where small birds are abundant. In such places it is now proved that there is a tremendous struggle with an immense mortality, in spite of the brevity of the pupal stage (from ten days to three weeks in length)." Question (2) was approached by attaching the pupae "to surfaces which unequally concealed them; thus the rough surfaces of stone and bark (rough-barked trees being almost invariably selected), and the shelter afforded by overhanging leaves of nettle, concealed their rough angular forms far more than the comparatively smooth surface of fences. . . . At Oxford butterflies only emerged from pupae fixed to nettles, while in the Isle of Wight the mortality on fences (90 taken to 8 emerged), was enormously greater than on bark (135 to 84), walls (14 to 12), and nettle (20 to 15). When therefore the pupa is suspended from a surface against which it stands out conspicuously, it is in far greater danger than when it is fixed to one upon which it is concealed."—E.B.P.]

and relatively how frequently? In these tables there is nothing to show that of a family, with, say, 500 genera, more than fifty or a hundred are habitually taken, though it is only fair to say that these figures are sometimes amplified in the text.

An important omission in the presentation of the case for indiscriminate predation is that we are told only occasionally and casually how the food was distributed among these 80,000 stomachs. It is important because it is a fact well known to field ornithologists, and one which has been demonstrated experimentally, that birds do not all eat the same things, and that they will on occasion discriminate between the palatable and the edible. The evidence from the careful experiments of Swynnerton and others cannot be lightly set aside. In this country, the Song Thrush is the only bird known to take the snails *Helix aspersa* and *H. nemoralis*; and it takes them in largest numbers in time of drought when they are hidden in sheltered places and thus are least "available." If an analysis of thrushes' food was made on the lines of McAtee's tables, it would be very misleading unless regular samples of the birds were taken from the same area throughout the year. In the recent inquiry into the status of the Great Crested Grebe in this country (*British Birds*, 1932) it was found by Harrisson and Hollom that fish, if present, forms a high proportion of the food; but if it is not available, the grebes thrive equally well, and will colonise new waters, on a vegetable and insect diet.

I attempted last summer to feed Coots with wasps, insects which are commonly held to be distasteful to most birds, and recognised as such by their coloration. Living wasps, floating on the water, were not touched except twice when the birds were excited with fighting for other food. Then in one case a Coot, and in the other a Mallard, picked up a wasp but immediately rejected it, shaking and wiping their bills. Bread with a living wasp attached to it was invariably passed over; and that this was not due simply to distrust of unknown food was shown by the fact that when a split raisin was put on the bread instead of the wasp, the whole crust was taken at once, fruit and all.

Again it is a pity that an attempt is made to demolish the older view by citing examples that do not help the case. Thus we are told that certain moths, which look like bird droppings to the human observer, cannot be protected by their appearance, not because the predatory birds see through the deception, but because "birds habitually devour the excreta of their young." As every field ornithologist knows, not all, or even most, birds eat the excreta of their nestlings; and in any case the act is limited to the few days when the young are fledging in the nest. To the argument that the development of spines and hairs in caterpillars is in the main a phyletic character and not an adaptation to defence, it might be rejoined that this cuts both ways; and that if it is a family characteristic of some caterpillars to produce hairs, some birds may equally well have developed the capacity to swallow them. This is in fact what I believe has taken place. For instance, bumble-bees are common and widely distributed in this country, but few birds are recorded to prey upon them except the Redbacked Shrike and perhaps the Spotted Flycatcher. I have, however, twice seen Common Wheatears killing and eating *Bombus*, and I once shot a bird with its stomach full of bees. Miss Turner tells me that she has seen the Cinnabar Moth fed to young Wheatears (p. 97); and it may not be without significance that Colthrup recorded that the imagines of Chalk Hill Blue butterflies were fed to the nestlings of the allied chat, the Stonechat. This

suggests that the Wheatear is willing to take insects that are usually assumed to be unpalatable; and it may be this family faculty that has enabled this genus to spread and thrive in desert places from the arctic to the tropics. In this connection the data supplied about ants repay study. There were identifications from 12,743 stomachs, belonging to over 300 species of birds. Elsewhere in the text we learn that of these birds 166 species had less than 10 records apiece. In fact the ants may have been picked up accidentally or under stress of famine. Of the other 134 species, 93 had 10 to 49 records each, 18 had 50 to 99 each, 17 had 99 to 100, 4 had 300, and one had 500. The big drop between 93 and 18 is interesting. We are nowhere told exactly what the species of birds were, nor how many ants each took, beyond the fact that large quantities, running into three and four figures, were found in the Swallow, the Nighthawk, the Woodpeckers and the genus *Hylocichla*. We also learn incidentally that the tables include records from sixteen species of Woodpeckers and five species of *Hylocichla*. Now in the Old World, the Woodpeckers are the outstanding bird predators upon ants—Collinge says that the Green Woodpecker in this country takes ants as 20% of its food—and so it is not surprising to find the same family in the United States consuming ants up to 80% of their total subsistence (according to McAtee). He also remarks that ants account for 12·5% of the food of *Hylocichla*. The Swallows almost certainly, and the Nighthawk very probably, judging from their habits, were taken while preying on the winged sexuales of the ants at swarming time when they are present in the air in great numbers. These figures for ants are most interesting, but in the face of them surely it is misleading to say with McAtee (p. 93): "All birds eat ants"; or even with Uvarov (*Nature*, Nov. 5th, 1932): "More than three hundred species of American birds feed upon ants." On the contrary, they suggest that while ants are certainly eaten by birds, they are only taken habitually or in large quantities by certain groups which have developed a taste for this form of food. The figures given by McAtee for the poisonous harvester ant, *Pogonomyrmex*, are also most instructive. There were 66 records of this genus being taken by 25 species of birds. This surely looks as if the birds, though willing to experiment in diet, were not very satisfied with the results of their experimenting on *Pogonomyrmex*.

The figures for Rhynchota are curious and lead to the surprising conclusion that birds prefer Heteroptera to Homoptera. One is tempted to suggest that the softer-bodied aphides and leafhoppers are more quickly digested and rendered unrecognisable in the stomachs; and the relatively higher proportion of the harder chitinised MEMBRACIDAE that appear to have been taken supports this view.

The figures for Heteroptera are curious. Those for *proportion taken* and *abundance* balance nicely for the REDUVIIDAE and LYGAEIDAE. But for COREIDAE the low proportion taken can hardly be accounted for by the large size of some of the species (the explanation offered by McAtee) when we find that the PENTATOMIDAE, which are often equally large, are taken no less than five times as frequently as their abundance index justifies. And the MIRIDAE, of which McAtee says: "corresponding with their abundance and wide distribution, we find them preyed upon by 108 species of birds," we find from the table are taken at only one-sixth the rate which the theory of indiscriminate predation demands.

In conclusion this paper brings home to us how little we really know about the food of birds; and in this country investigation is a good deal hampered through dread of the protest that would be aroused by various semi-humanitarian protectionist bodies if a long series of dead birds was obtained for the purpose. Fortunately the work of the United States Biological Survey has been unaffected thereby; and the data collected by McAtee and his colleagues are the most weighty contribution to the knowledge of birds' food that has yet appeared.

Mr. H. B. Cott.

1. In his attempt to prove that protective adaptations of animals are ineffective against predatory birds, McAtee bases his conclusions upon the principle of "proportional predation." On p. 144 of his recent publication he makes the claim that "Within size limits, animals of practically every kind accessible to birds are preyed upon, and as we consider the records for group after group a tendency for the *number of captures* to be in proportion to the *abundance of the animals* concerned is unmistakable" (italics mine). Now, McAtee neither gives us the number of captures, nor does he show that the numbers which he does give bear any relation to the abundance of food-animals in nature. His records refer rather to the *number of birds' stomachs* containing different types of food—a method of tabulation which, by itself, may give an entirely false notion of the proportions of different kinds of prey actually eaten.

The essential figures which we require in considering the efficiency of protective adaptations are those which show the relative numbers of prey eaten, rather than the number of stomachs from which the prey is recorded. This point will be made clear by a single example, namely the food-habits of the East African tree frog *Megalixalus fornasinii*. Examination of a series of 360 frogs indicated that numerically Aphids constitute the main food eaten, these forms amounting to 423 out of 1119 food-animals identified. The stomachs of several frogs were crammed with the insects, which are obviously not distasteful to the frogs. Yet only 8 (2·2 per cent.) frogs had been feeding upon Aphids, and if we adopt McAtee's treatment of data, Aphids would appear to represent not 37·8 per cent., but 3·3 per cent., of the food of the 245 frogs with recognisable stomach contents.

In other words, according to this method of treatment, a predatory animal whose stomach and gut was distended with a mass of insects of a single kind, amounting perhaps to many hundred specimens, would be recorded no differently from one which had casually swallowed a single example of the same species. I therefore wish to point out that in the absence of numerical analyses of stomach contents, McAtee's figures are misleading, and the conclusions which he draws from them unjustified.

2. A more important point is the fallacious belief that proportional predation "means that predation takes place much the same as if there were no such thing as protective adaptations." McAtee's figures have reference to the various groups of food-animals eaten by "a wide range of species of all the families of birds occurring in the [Nearctic] region" (p. 6). This collective treatment of data takes no account of discrimination in the choice of food by *species*. Whether or not animals are

eaten in proportion to their abundance in nature is still open to question; but, as I have stated elsewhere,* the real point at issue is to determine whether this proportion—whatever it may be—would remain unaltered in the absence of the adaptations whose effectiveness McAtee attempts to disprove. In other words, are these adaptations effective against *some* species?

Analysis of food eaten by predatory species severally points definitely towards selection rather than indiscrimination in the choice of food. If predatory animals are indiscriminate feeders, and if availability be such a " mighty factor " as McAtee supposes, then should we not expect to find that " within the limits imposed by . . . bodily modifications, and the relative sizes of predator and prey," birds and other animals feeding in the same habitat would show close agreement in their diet? Do we in nature find this close agreement? As regards birds, this is a question for ornithologists to answer. In reference to Anura, I submit the view that we do not. Even with these lowly vertebrates, the known facts indicate that selection is a factor of which we must take account.

In my paper on the predatory habits of East African Tree Frogs (*Proc. Zool. Soc.*, **1932**) will be found a considerable body of evidence of discrimination in the choice of insect-food. This is supported by more recent work on British frogs and toads, which it is hoped to publish shortly. Here we can do no more than call attention to the fact that in different genera taken under uniform conditions and in the same habitat, the food differs markedly, as will be seen from the following data :

1. Tree frogs from the palm forest region of the Lower Zambesi Valley.

Food.	*Megalixalus fornasinii* (360).	*Hyperolius bayoni* (110).
Lepidoptera	4·8 per cent.	·2 per cent.
Diptera	26·3 „ „	·4 „ „
Hemiptera	46·3 „ „	1·6 „ „
Formicidae	10·8 „ „	96·2 „ „

2. Frogs and toads from heather-moor, Lands End.

Food.	*Rana temporaria* (17).	*Bufo vulgaris* (45).
Mollusca	24·8 per cent.	·6 per cent.
Lepidoptera	13·4 „ „	2·4 „ „
Diptera	9·1 „ „	·9 „ „
Formicidae	·4 „ „	41·4 „ „

The theory of proportional predation is not supported by the above figures, which illustrate rather how the comparative study of predatory habits in insectivorous vertebrates points to selective discrimination in the choice of food.

3. In reference to the protective adaptations of ants, there is no doubt that these insects constitute an important item in the diet of Anura in general, and in many species whose food-habits have been carefully analysed it is evident that these insects make up the bulk of the food eaten. The same is true of some lizards, notably the AGAMIDAE. The facts, as regards some species investigated by the writer, are tabulated below :

* 1932, *Nature*, **130** : 962.

Species.	Number of Predators.			Number of Prey.		
	Number of predators with recognisable contents.	Number of predators containing ants.	Per cent.	Total number of insects, etc., eaten.	Number of ants.	Per cent.
Agama hispida armata .	11	11	100·0	266	225	84·6
Agama atricollis . .	6	6	100·0	561	539	96·1
Agama mossambica . .	9	9	100·0	543	510	93·9
Hyperolius marmoratus .	38	35	92·1	2675	2609	97·5
Hyperolius bayoni . .	107	104	97·2	3688	3547	96·2
Hyperolius argus . .	?	?	?	3300	3080	93·3
Megalixalus fornasinii .	245	67	26·4	1119	121	10·8
Phrynobatrachus acridoides .	15	15	100·0	602	553	91·9
Hyla arborea . . .	183	136	74·3	1210	695	57·4
Bufo vulgaris . . .	148	126	85·1	7918	4103	51·8
Rana temporaria . .	89	6	6·7	1010	7	·7

The point to which I would draw attention here is that although the protective adaptations of ants are evidently ineffective against the attacks of many specialised enemies among lizards, toads and frogs, yet these insects appear to be well protected from certain species, as, for example, the common frog (*Rana temporaria*). Thus, of some 9000 food-animals recovered from the alimentary tracts of 238 frogs and toads collected during six months in various localities in the south of England, the figures relating to ants are very striking:

4103 ants were recovered from 126 out of 148 toads examined;
7 ants were recovered from 6 out of 90 frogs examined.

The frogs were taken at almost every hour of the day and night, in situations where ants abounded, frequently in close company with toads whose stomachs were stuffed with the insects; yet in only one stomach were found two ants, and in five others (out of ninety examined) a single ant. In striking contrast, the toads relish ants, six individuals having eaten 112, 138, 210, 251, 341 and 363 specimens respectively.

These facts do not look like "proportional predation." Nor do they support McAtee's unconsidered statement that "Ants are not rejected either relatively or absolutely by any potential predators."

Communications following the Discussion.

Observations on insects eaten or rejected by British birds, by Miss E. L. Turner.

[Communicated by Prof. Poulton. See p. 86.]

1. *Ganoris* (*Pieris*) *brassicae*, L.—Large Garden White butterflies during migration at Scolt Head were pursued and eaten by Terns, Swallows and Gulls. June 4th and 5th, 1925. (*Bird Watching on Scolt Head*, E. L. Turner, Lond., 1928, p. 21.) The present watcher states that this has occurred several times since this date.

The garden of my neighbour, the Rev. G. H. Harris, has suffered much from Large Cabbage White butterflies this summer (1932). On Aug. 18th, at 7 p.m., a large flock of Black-headed Gulls was seen by him and his gardener chasing

these butterflies high up in the air. He also informs me that these butterflies every evening after playing round his apple trees for a little while towards sunset, then rose high into the air and disappeared. Only on this one occasion did he see them attacked by Gulls.

2. *Euchelia jacobaeae*, L. (Cinnabar Moth).—Wheatears (*Oenanthe oenanthe*, Linn.) sometimes feed their young on Cinnabar Moths.

3. *Larva of Arctia caja*, L. (Garden Tiger Moth).—Woolly-bear larvae are usually devoured only by Cuckoos. I once watched a Mistle-thrush (*Turdus viscivorus*, Linn.) spend 20 minutes turning one inside out so that the long hairy bristles were enveloped in a pulpy mass. This was taken to the young.

4. *The Hive-bee.*—Great Tits (*Parus major*, Linn.). I was shown by a bee-keeper a mound, a foot in height, which consisted entirely of the abdomens of hive-bees.

5. *Ants.*—Ants near the nests of Willow Warblers (*Phylloscopus trochilus*, Linn.) are angrily flicked away, *not* eaten.

6. *Winged ants.*—During a two days' pest of winged ants at Scolt Head, Black-headed Gulls (*Larus ridibundus*, Linn.) greedily chased and devoured them (*Ibid.*, p. 72).

7. *Dragonflies.*—The following birds—Wheatear (*Oenanthe oenanthe*, Linn.), Swallow (*Hirundo rustica*, Linn.), Corn-Bunting (*Emberiza calandra*, Linn.), Reed-Warbler (*Acrocephalus streperus*, Vieillot), Sedge-Warbler (*A. schoenoboenus*, Linn.), occasionally feed their young on the blue "demoiselle" dragonflies (Odonata). The brown are equally common but not so conspicuous.* The ordinary food of these birds consists of Diptera and various larvae.

* My friend Mr. F. J. Killington writes, 14 December, 1932 :—

"Miss E. L. Turner's dragonfly is almost certainly *Calopteryx virgo*, L. It is the species popularly known as the 'demoiselle,' and is, moreover, the only British species in which the males are blue (body and wings) and the females brown (wings).

"Miss Turner's observations remind me of an experience of mine during several years. I repeatedly found large numbers of wings of *Calopteryx splendens*, Harris, scattered on the tow-path beside the R. Itchen between Eastleigh and Winchester—obviously the result of bird-attacks. On some days I could have collected hundreds of wings on a stretch of a hundred yards of the path. Wings of both sexes were present, those of males by far the more numerous. I never succeeded in witnessing an actual attack, although I spent much time in the locality.

"In *Calopteryx* the males are much more conspicuous than the females, and I can suggest no other reason for the *apparent* immunity from attack of the brown females suggested by Miss Turner's observations.

"Perhaps the earliest observations of bird attacks on dragonflies are those of Gilbert White in his letters to the Hon. Daines Barrington. In Letter VII, 8 Oct., 1770, he states that in July he saw several cuckoos skimming over a large pond (from which we must conclude that the species was not a *Calopteryx*), and feeding upon dragonflies. These they caught both on the wing and while the insects were settled on the weeds. Again in Letter XXX, 3 Apr., 1776, he records the finding of dragonflies in the digestive organs of a cuckoo, and remarks that he had witnessed cuckoos catching these insects on the wing just as they were emerging from the 'aurelia state.'

"W. J. Lucas (1900, *British Dragonflies*, p. 6) gives a little information on the subject. He states 'What natural enemies the Dragonflies have in this country will usually be found amongst the birds, and their number is no doubt small.' He gives one or two references to bird-attacks recorded in the *Entomologist's Monthly Magazine*. Furthermore, R. J. Tillyard (1917, *The Biology of Dragonflies*, p. 330) dealing with the enemies of dragonflies states 'Birds frequently attack Dragonflies; but, as far as my observations go, seldom succeed in catching them. The kingfishers are an exception, as they are wonderfully expert at catching Dragonflies skimming close to the water.'"

Dr. G. D. Hale Carpenter has also observed that "both large and small Dragonflies are favourite articles of food of the bee-eater *Merops superciliosus*" and also of *Melittophagus meridionalis*, on Lake Victoria (*Naturalist on Lake Victoria*, Lond., 1920, pp. 172, 310).—E.B.P.

Experiments and Observations in 1931 on the young Purple Martin (*Progne purpurea*, L.) conducted near Milwaukee, Wis., U.S.A., by Miss E. A. Oehlenschlaeger.

[Communicated by Prof. Poulton. See p. 86.]

Soon after the Fifth International Entomological Congress in July, 1932, my friend Prof. Julian Huxley directed my attention to a paper in *Bird-Lore*, **34**: 245–252, July–August 1932,—" The Martin Quartet of 'the Hummocks,'" by Elizabeth A. Oehlenschlaeger of Milwaukee, Wisconsin. The authoress received on 15 and 16 July, 1931, four young of the Purple Martin (*Progne purpurea*, L.), thrown out of nests during a period of drought. They were fed, and by 6 August were allowed to fly but always returned and would alight on the head or arms of the authoress and her friends. An insect diet was found to be a necessity for them.

" Their growth as a result of this effort was remarkable, and it brought about an interesting bit of information: any moth or butterfly with brilliant colouring was refused as food. We tried this thoroughly without avail. Grasshoppers, dragonflies, beetles on the wing—all these they ate; none of us realized that our alfalfa-field had such a world of insect-life!" (p. 248.)

One of the little community was accidentally drowned, but the remaining three joined a migrating band on 15 September, 1931. The raising of these nestlings to the migratory flight is believed to have established a national record. " The Hummocks " where this interesting experiment was successfully carried on, is on the shores of Lake Michigan, 15 miles N. of Milwaukee.

At Prof. Huxley's suggestion I wrote to Miss Oehlenschlaeger in order to learn, if possible, the names of some of the brightly coloured insects which were refused and of others that were accepted. To her kindness and that of Mr. Henry Rich, Assistant Curator of Entomology at the Milwaukee Public Museum, I owe the opportunity of recording the interesting facts here published.

The following butterflies, recognised from Dr. W. J. Showalter's plates in *Nat. Geogr. Mag.*, **52**, were refused :—*Danaida plexippus*, L., *Euvanessa antiopa*, L., *Argynnis diana*, Cram., *Glaucopsyche lygdamus*, Doubl., *Papilio polyxenes*, F., *P. glaucus*, L. (♂ and ♂-like ♀).

Accepted—*Ganoris* (*Pieris*) *rapae*, L. *Callidryas* (*Catopsilia*) *eubule*, L., was " taken at first, I think, because I could push the insect into the open mouth far enough to make regurgitation impossible. Later, when the birds became more independent and ate normally the flavor of this particular butterfly ceased to appeal to them."

The following moths were refused :—the Sphingid *Protoparce q. quinquemaculatus*, Haw., and the Arctiine *Eubaphe aurantiaca*,* Hübn.—" the first brightly coloured species to be refused." Another Arctiine *Halisodota tesselaris*, Abbot & Smith, of which " huge swarms feasted on the Sedum and Privet blossoms," was refused until the scales were rubbed off, but then " particularly relished." It is evident that night-flying moths with sober colours were freely taken, for Miss Oehlenschlaeger informs me that, " during a period when day-flying insects were

* Figured by Dr. F. Morton Jones in 1932 *Trans. Ent. Soc. Lond.*, **80**: pl. xviii, fig. 12, and given the low acceptability rating of 14·0 as the result of his experiments.

not very numerous we placed lighted candles on the window-sills indoors and then captured the gathering moths in a box as they flew against the window-panes. Hundreds were caught in this way and usually made a 'snack' before retiring and sometimes an early breakfast, for our birds."

Insects of other Orders, so far as they were offered, were accepted. Among the Odonata the following dragonflies were recognised from the plates of Dr. Lutz's *Fieldbook of Insects*—*Anax junius*, Drury, *Libellula pulchella*, Drury, and *Hetaerina americana*, F. The following note proves that the behaviour of the Martins was absolutely natural—"Many varieties of dragonflies were caught by the birds after they foraged for themselves. As they always came in response to a peculiar whistle they would carry their prey down to us, finish eating on our outstretched arms and then consume whatever 'tidbit' we had for them."

The Mayfly (Ephemeroptera), *Ephemera varia*, Eaton,—also recognised, with the remaining insects here mentioned, from Dr. Lutz's plates.

The following grasshoppers (Acrididae)—*Dissosteira carolina*, L., *Schistocerca americana*, Drury, and *Spharagemon bolii*, Scudd.; also the crickets (Gryllidae)—*Gryllus domesticus*, L., and *Nemobius* sp.

"The Martins were very fond of crickets, although I doubted whether these little black insects would normally interest them. But Mr. Owen Gromme, of the Department of Ornithology, assures me that he has seen these birds waddling on their short stubby legs along the shores of Lake Michigan, gathering insects after the manner of the sandpipers and snipes."

The fact that the Martins rejected *Euvanessa antiopa* and accepted the Acridian *Dissosteira carolina* is of interest in relation to the suggestion that the latter in flight may be a mimic of the former.*

It is interesting to compare the above record with Prof. Beal's account † of the Purple Martin's insect-food, founded on an examination of 205 stomachs. Hymenoptera—23% in 129 stomachs, including 11 hive-bees, all males, in 5 stomachs; Diptera—16·09% in 50 stomachs; Hemiptera—14·58% (Pentatomid bugs being among the most abundant) in 70 stomachs; Beetles—12·53%; Lepidoptera—9·39%, include a Red Admiral (*V. atalanta*) in 1 stomach (possibly "more butterflies which could not be identified"), small moths in 39 stomachs and the sole contents of 11 (in 1 twelve heads counted); Dragonflies in 67 stomachs and sole contents of 7: of these insects "the total for the season is 15·1 per cent. of the food, a percentage unusually large for these insects and indicating that the martin hunts specially for them." Orthoptera were sparingly eaten, being 1·09% of the yearly food. "A few other insects, spiders, &c.—8·09%—complete the food. (pp. 3–5.)

Orthoptera were also scantily represented in the food of other swallows studied by Prof. Beal. The freedom with which they were taken in Miss Oehlenschlaeger's experiments is probably to be explained by the needs of the young, rapidly growing birds. The Lepidopterous and Odonate food accepted by the young swallows is consistent with the examination of stomach-contents, but we learn much more

* Verh. III. Internat. Ent.-Kongr., Zürich, July 1925, Weimar 1926, **2**: 535, 536.

† "Food habits of the Swallows," &c., *U.S. Dept. Agric., Bull.*, **619**, Washington, 1918.

from the refusals of brightly coloured insects recorded by Miss Oehlenschlaeger; and her whole account, with that of many other naturalists, form a convincing reply to Dr. McAtee's confident assertion that the results of feeding experiments are useless and might as well be discontinued (1912 : p. 364).

Evidence of the Effectiveness in Nature of the Protective Adaptations in some Insects as illustrated by the Food-Habits of certain Nearctic Birds.

[Drawn up and communicated by Prof. Poulton. See p. 86.]

My attention having been drawn by my friend Dr. G. D. Hale Carpenter to two valuable papers on the food-habits of Californian birds by F. E. L. Beal, issued in 1907 * and 1918,† I thought it would be interesting to ascertain the views of an American naturalist whose records have doubtless furnished Dr. McAtee with some of his most valuable material. The late Prof. Beal, who is described by the Editor as " the most experienced economic ornithologist in the country, died on October 1, 1916, shortly after the preparation of this paper " (1918 : p. 1, n. 1).

The following general statement by the author raised the expectation, which was abundantly realised, that his observations would prove that there was something more than " the influence of availability in guiding choice of food by birds " :—

" It is seldom that complaints are made of birds in general; one or a few species are usually the culprits, the reason for which is evident—too many individuals of the same species in one locality eating the same things. But when many species are present in normal numbers, such a variety of tastes is to be gratified that no one kind of food is unduly drawn upon " (1907 : p. 13).

Carabid beetles neglected by certain birds.—Dr. McAtee's pronouncement on this subject is as follows :—" It is everywhere evident that the special defenses alleged for the Carabidae are more in the nature of pleasing fictions for theorists to speculate upon than practical reliances for the beetles concerned " (1932 : p. 69). This comment follows a quotation (p. 68) from S. A. Forbes,‡ containing the statement that there is " a remarkable deficiency of the highly colored [Carabid] genera . . . which are either absent, or found but rarely in these birds' (thrushes, bluebird) food. Evidently these more showy beetles are protected by some more effective means than obscurity of color."

Forbes' opinion is confirmed by F. E. L. Beal (1907 : p. 92) in the following passage which is of special interest as showing, not only the neglect of CARABIDAE, but the strong preference for weevils. The bird referred to is the Hermit Thrush (*Hylocichla guttata*) of which 68 stomachs were examined.

" Predatory beetles (Carabidae) are noticeable by their absence, as only a few remains of them appear. Beetles of other families . . . form 11 per cent. of

* " Birds of California in Relation to the Fruit Industry," Pt. I, by F. E. L. Beal, Assistant, Biological Survey. *U.S. Dept. of Agriculture, Biological Survey, Bull.* **30** (issued 11 Nov. 1907), Washington, pp. 1–100. To be quoted as " 1907 : " followed by the page or pages.

† " Food-habits of the Swallows, a Family of valuable Native Birds," by F. E. L. Beal, Assistant Biologist, *U.S. Dept. of Agriculture, Bull.* **619** (issued 8 March 1918), Washington, pp. 1–28. To be quoted as " 1918 : " followed by the page or pages.

‡ *Bull. Illinois State Lab. Nat. Hist.*, **1** (6) : 57, May 1883.

the food. Weevils . . . constitute more than two-thirds of these, which would seem to indicate that they are a favorite food. When we consider that the carabids live on the ground, and are the most abundant and most easily obtained of any of the common beetles, and note how few of them the hermit thrush eats, while on the other hand it eats many snout-beetles, which, living to a great extent on trees, are generally much more difficult to find, we are forced to the conclusion that the latter are a preferred food, and that they are purposely sought for " (1907 : p. 92).

Important attacks on Coccinellid beetles, especially the larger, more conspicuous species, almost restricted to a single genus of birds.—Comparing the ENDOMYCHIDAE and EROTYLIDAE with the COCCINELLIDAE Dr. McAtee remarks, " The former are relatively seldom captured, the latter are freely eaten. No better example of the influence of availability in guiding choice of food by birds could be desired. . . .

" Not only is the effect of availability noted in birds eating more Coccinellids than other similar but less abundant and conspicuous beetles, but its influence is evident in at least two other ways, namely that leaf-feeding birds, as warblers and vireos, get the most ladybird beetles, and that in California where Coccinellids are notably more abundant than they are in the eastern States, a larger number of birds feed upon them and they get a great many more of the beetles " (1932 : p. 73).

Beal's record of the insect food of Californian birds lead to the very different conclusion that, with the possible exception of the Pigmy Nuthatch, the only serious attacks on COCCINELLIDAE are made by specialised enemies in the single genus *Vireo*, and in this genus by all the species. He gives the following data for three of them :—

Vireo gilvus swainsoni :—110 stomachs examined : over 19% of the diet made up of Coccinellids : none in October : but over 63% of the whole found in July stomachs : Coccinellid species belonged to *Hippodamia* and *Coccinella* " larger than those of the genus *Scymnus* selected by the warblers " : other beetles, over 7%; Hymenoptera, " a few ants and an occasional wasp "—a little over 1%. The chief food is Lepidopterous—over 43%, and Hemipterous—21% (1907 : p. 39).

Vireo solitarius cassini :—46 stomachs with little less than 6% of Coccinellids (pp. 40, 41). This percentage, though " very moderate for a vireo," is " much greater than that of any bird outside the present genus, except the pygmy nuthatch " (*Sitta pygmaea*) with 9·6% in 31 stomachs, a number considered to be insufficient by the author (pp. 67, 68).

Vireo huttoni :—54 stomachs with 8% of Coccinellids; beetles as a whole, nearly 11% (p. 41).

" Several other species and subspecies of vireos occur in California, but in the general character of their food they agree closely with the foregoing " (p. 42).

Beal's records of Coccinellid food eaten by birds other than the above-mentioned species are also of much interest.

Polioptila spp. (Gnatcatchers) :—30 stomachs of *P. c. obscura* and 30 of *P. californica* were examined, their contents being " so similar that they may be treated as from a single species." " The food of the gnatcatchers is remarkably constant in character throughout the year, varying but little from month to month.

It is probable that these birds have a preference for a certain diet; and search till they find it" (p. 85). This diet was made up of Hemiptera—64%; wasps, small bees and a few ants—over 16%; caterpillars—about 5%; other insects such as flies and grasshoppers—6%; beetles—over 7%, including 2 examples, in separate stomachs, of the very abundant ladybird *Coccinella t. californica*. These, both eaten by *Polioptila californica*, must of course figure in Dr. McAtee's lists as of equal value to the Coccinellids, however many, in two stomachs of *Vireo gilvus swainsoni*, a specialised enemy of these beetles. Looking at the record of the Gnatcatcher as a whole it is clear that ladybirds are disliked and that these two exceptions were eaten in special circumstances—such as hunger due to the needs of nestlings or some other cause. Their presence, accepted by Dr. McAtee as evidence for palatability, in reality emphasises the Gnatcatcher's general dislike for these insects.

Another interesting note on the Coccinellid-eating birds outside the Vireos, appears under *Regulus calendula* (pp. 81–84)—294 stomachs examined, with 13% of the season's diet made up of Coleoptera, including less than 2% of Coccinellids (8% in February, but in no other month as much as 2%). "Almost all of these belong to the genus *Scymnus*, which is made up of minute black creatures which one might think would pass unnoticed by birds. On the contrary, the small and insignificant individuals of the genus appear to be eaten much oftener than the larger and more showy species" (p. 82).

Discrimination against Pentatomid bugs.—The food of the last-mentioned bird, *Regulus calendula*, included species in 3 families of Hemiptera–Heteroptera and 5 of Homoptera, the whole making nearly 26% of the diet, but the PENTATOMIDAE "which are the most universally eaten by birds of any Hemiptera, are entirely wanting. Evidently it was not lack of opportunity that prevented the Kinglets from eating the last-named insects, for other birds collected at the same time and place had partaken of them freely" (p. 82).

*Drones of the honey-bee "deliberately selected" by the Cliff or Eaves Swallow (Petrochelidon lunifrons).**—In 11 out of 123 stomachs, representing every month from April to September inclusive, 34 honey-bees were found (8 in a single stomach). All were males without a trace of a worker. "In two stomachs drones constituted the whole food and in several others the principal part. It is probable that most of them were taken when the queen made her marriage flight" (1907 : p. 28).

In the later paper the number of Eaves Swallows' stomachs examined had been increased to 375, and "the remains of 35 honey bees (*Apis mellifera*) were identified in 13 stomachs. More were probably present but unidentifiable. All were males or drones. To what extent birds select their food has long been a matter of conjecture. When it is considered that the worker bees in the hive far outnumber

* Dr. F. Morton Jones in our 1932 *Transactions* (p. 362) quotes another of Prof. Beal's papers (*Biol. Surv. Bull.* **44**) in which the numbers of hive-bees swallowed by two other birds (Kingbird and Ark Kingbird) are given. These, added to the number eaten by 2 species of swallow, he shows to make 138 bees, of which 126 were stingless drones, in 1354 stomachs (the 46 bees in the 580 stomachs of the swallows being *all* drones). Dr. F. M. Jones also quotes Prof. Beal's figures for the number of Meloid beetles of the genus *Epicauta* in the stomachs of the Kingbird as contrasted with those found in other birds (p. 363), a comparison which I hope will be considered side by side with those in this section.

the drones, it is evident that the foraging birds must meet many workers where they encounter a single drone. Evidently the drones are deliberately selected by the eaves swallow, for not a trace of a worker bee was found in any stomach" (1918 : pp. 8, 9).

Eleven hive-bees, all drones, were also found in 205 stomachs of the Purple Martin (*ibid.*, p. 3), other food being summarised on p. 99. Also a single drone was found in one of 467 stomachs of the Barn Swallow (*Hirundo erythrogaster*)—a great enemy of other Hymenoptera, especially ants,—and none in the stomachs of two other swallows with similar tastes (1918 : pp. 11–25).

I do not find any reference to this most interesting discrimination between the stinging and non-stinging sexes in Dr. McAtee's two papers—only the erroneous statement that "bees all sting," followed by the conclusion that "the 797 records of their being eaten by the birds examined by us would seem to indicate considerable disregard of the stings on the part of birds"; also the usual appeal to "availability" as the explanation of the attacks made on honey bees (1932 : p. 94).

I need not refer again to the deliberate selection of stingless drones, included in McAtee's total of 797, and accounting for 126 out of the 139 Apidae tabulated by him (*ibid.*, p. 91). It is, however, necessary to correct the belief that "bees all sting." A good example of an important group of stingless bees, widespread through the tropics, is given by R. Shelford :—

"The little Dammar-bee *Melipona vidua* (Lep.), black with white-tipped wings, is an extremely common insect in Borneo, and though stingless, is protected by its ferocious biting and social habits." He also shows that it is mimicked by a great variety of insects (*Proc. Zool. Soc. Lond.*, **1902** : 267–71, pl. xxiii, figs. 37–47).

I venture to quote the results of an experiment made over 40 years ago in order that it may be read beside Beal's valuable records.

A worker hive-bee was liberated in the cage containing a chamaeleon, which "immediately began to watch it, and, as soon as it had settled, captured it with a dexterous shot of its long tongue. As the tongue was being withdrawn with the bee adhering to the sticky pad at its extremity, the chamaeleon was stung and immediately showed signs of discomfort, throwing its head from side to side, and thus jerking the bee off. For many months after this I put bees into the cage at irregular intervals; but the chamaeleon's education in this direction was complete, the single experience was sufficient, and no other bee was touched." * I feel sure that, in spite of Dr. McAtee's confident assertions about "imaginative inferences" and other attempts to depreciate the value of such experiments as this, naturalists generally will agree that the behaviour of this chamaeleon sheds much light upon the theories of Warning Colours and Mimicry, and that, most important as were the results of Beal's investigations, the experiment teaches us facts about this lizard's psychology—its power of instant association and its memory—which no examination of stomach-contents could yield. It must be remembered, too, that the chamaeleon was living in a roomy cage, healthy, and feeding freely for many months on insects with Procryptic colours and behaviour, often too protected by alertness and swift flight.

Ants specially selected by certain birds, specially rejected by others.—The Wren

* *Colours of Animals*, Internat. Sci. Series, Lond., 1890, p. 199.

Tit (*Chamaea fasciata*, s.-sp.) forms an interesting contrast with the California Bush Tit. 165 stomachs of the former, representing all months except July, contained ants and small wasps (in about equal quantities) making up 23% of the animal food (52%); beetles—about 10%, including " a few ladybirds "—less than 1%; caterpillars—a little less than 8%; Hemiptera—about 7%. " The remaining animal food, less than 5 per cent., is composed of various insects and some spiders " (1907 : pp. 71, 72).

The California Bush Tit (*Psaltriparus minimus californicus*). 353 stomachs were examined, representing every month, but in April only 1 and in March only 6. Hemiptera formed the chief food—over 44%; beetles—over 10%, including ladybirds of which a separate account was kept—total amount for the year 2·4%. " The food of the year gives nearly 81 per cent. animal matter, composed entirely of insects and spiders, to 19 per cent. of vegetable " (1907 : p. 74).

" Strangely enough, wasps and ants . . . are nearly absent from the food of this bird. The total amount for the year is less than 1½ per cent. In view of the fact that ants are always crawling over the trunks and branches of trees, the very places where the tits feed, it seems strange that so few of them are eaten. Moreover, plant-lice always have ants in attendance upon them, and when tits eat so many plant-lice it is rather remarkable that they should not take some of the ants also, as do the smaller woodpeckers, whose food habits are in many respects so similar. In 353 stomachs only two ants were identified, one in the adult and one in the pupal stage, and these were in separate stomachs. In 17 other stomachs a few fragments of what probably were small wasps were found, which make up the total of the Hymenopterous diet of the bush tit " (1907 : p. 78).

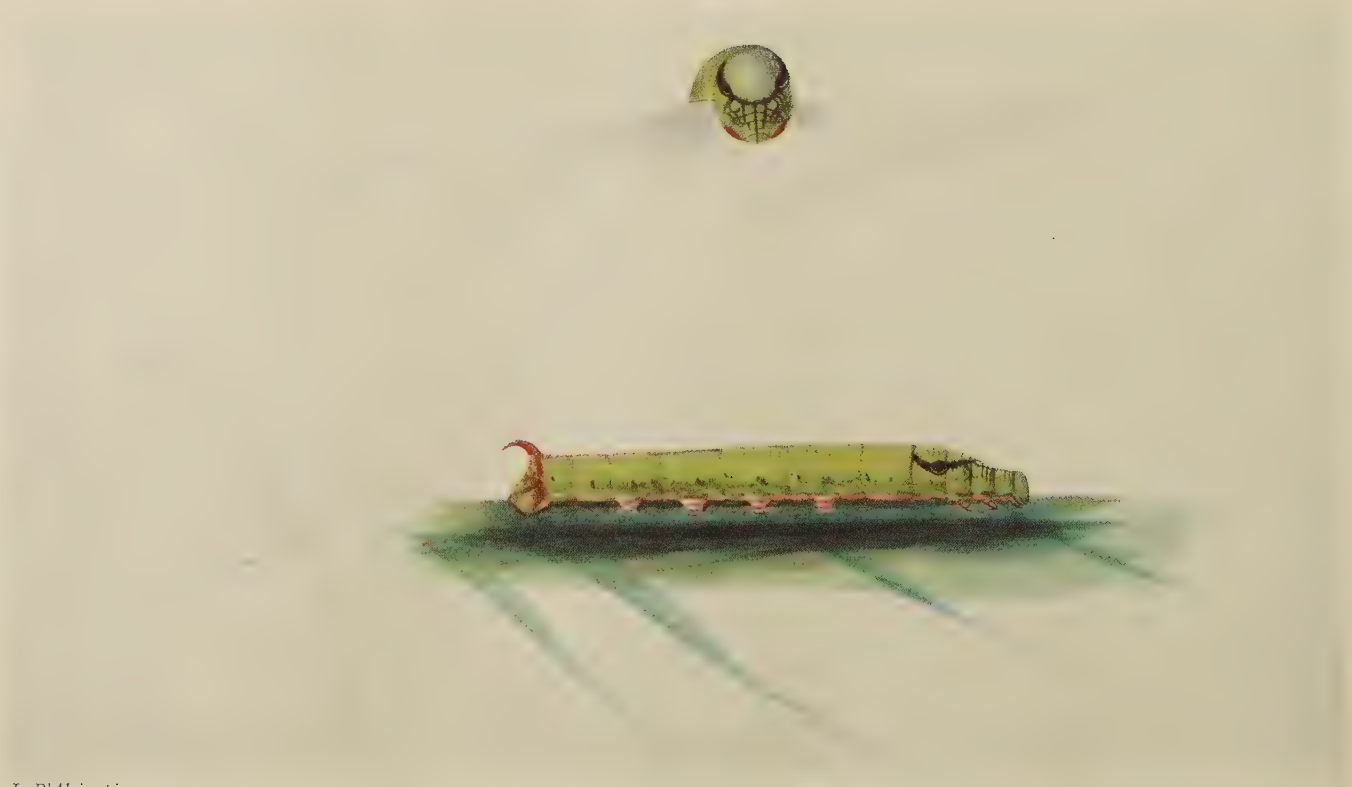
The Russet-back Thrush (*Hylocichla ustulata*), of which 157 stomachs were examined, forms another specially marked contrast with the Bush Tit. " Hymenoptera in the shape of ants . . . are eaten with remarkable regularity throughout the season, and form about 16% of the food. This is the largest insect element in the food of the thrush, and the regularity with which ants are eaten would seem to indicate that they are highly esteemed and especially sought for " (1907 : p. 87).

During the feeding of nestlings, however, " little opportunity is afforded the busy parents to select precisely the kind of insects best adapted to the wants of the young. Nature teaches that insect food and not vegetable is needed and the gaping mouths are filled with the nearest obtainable supply " (1907 : p. 90).

It is interesting to compare the above records with Miss E. L. Turner's observations on the behaviour of Willow Warblers towards ants, presumably workers, and of gulls towards the winged forms (p. 97).

It is also instructive to approach this subject from the side of the prey as well as from that of the captors and to note the existence of ant-communities flourishing nearly everywhere in spite of all the attacks made upon their members. And who doubts that ants " have many enemies ? Yet it will, I think, be clear to anyone who reads Mr. C. Elton's interesting paper * on ' Territory among Wood Ants,' that insects mistaken for ants in Dr. T. G. Longstaff's bird sanctuary at Picket Hill would, on the whole, be benefited by the resemblance and that the

* *J. Anim. Ecol.*, **1** : 69, May, 1932. The quoted sentence is from *Nature*, **130** ; 848, 3 Dec. 1932.



J. D'Alvis, pinx.

The Tree-viper like larva of the Oriental Hawkmoth, *Theretra s. silhetensis*, **walker.**

chance of being eaten as an ant by the Green Woodpecker would be a risk well worth taking."

The Tree-viper-like larva of the Oriental Hawkmoth, *Theretra s. silhetensis*, Walker.

Prof. Poulton said: The beautiful drawing reproduced on Plate I was presented to the Natural History Museum many years ago by my old friend Mr. H. N. Ridley, F.R.S. With his consent and that of the authorities in the Museum and with the aid of a grant from the Fund for Promoting Research in Evolution presented to Oxford University by my friend Prof. James Mark Baldwin, D.Sc., Oxon., this snake-like caterpillar, as seen from the side and also in the striking attitude and position it assumes when disturbed, has been made available for the study of naturalists interested in this form of Protective Mimicry.

Mr. Ridley kindly wrote, on 28 January, 1931, and several later dates, giving me the information quoted in the following paragraphs :—

" I went to the Museum to-day (28 Jan. 1931) and ran the moth of the viper-like caterpillar to earth easily. In fact, there is in the cabinet a specimen which I think I bred from the larva. It is *Theretra pinastrina pinastrina*, Martyn.* It is not in H. J. Kelsall's (and my) list of Sphingidae in the Singapore Gardens † because we did not take it at flowers, and therefore did not know it at the time. The caterpillar is quite green but for the head which, when contracted, is marked with scale-like lines and black and yellow ' eyes.' It feeds on the leaves of the Aroid *Homalomena*, sitting on the back of the leaf so as just to show its bogus head over the edge when alarmed, as in the plate. I have also seen a later stage of the larva brown, but not often. The snake it mimics, *Lachesis wagleri*, when young, is of about the same size as the larva and nearly always plain green like it, but I think with a trace of the red tail-tip, exactly like *L. gramineus* (Shaw), and sometimes with a few scattered reddish spots, but I have seen one at least which was mottled as in the adult. Also, in my ' Habits of Malay Reptiles ' (*Ibid.*, **32** : 202), I record that on opening a female *L. wagleri* (Boie) I found several young coloured like the adult,—mottled black, yellow and green, and one plain green. Cantor speaks of a row of cinnamon and buff spots on each side of the back of the young *wagleri*. Perhaps the lateral spots of the larva may represent these.

" *L. gramineus*, the plain green species, was the commonest poisonous snake in Cantor's time—1840 to 1852. It frequented open grassy fields, at least that is where I used to find it,—fields very liable to fire. *L. wagleri* was then rare, so that when I visited the Brit. Mus. to look at their snakes, I found almost all they had (from Cantor's Collection) were *gramineus*, and I think but one *wagleri* from Singapore. *Wagleri* sits on bushes and small trees in forests and so does not get burnt. Its colouring is adapted for concealment in the sun-flecked foliage of the forest. In my day *L. gramineus* had nearly disappeared, while *L. wagleri* was

* Dr. Karl Jordan, F.R.S., informs me that Martyn's *Psyche* (1797) is considered to be " unpublished " and the names are therefore invalid. The correct name is *Theretra silhetensis silhetensis*, Walker (1856).

† 1890, *J. Roy. Asiat. Soc., Straits Br.*, **22** : 324.

very common. No doubt the great clearing and burning of the open country by the Chinese after Cantor's time accounts for the change in abundance of the two snakes. Cantor states that *gramineus* ate largely *small* birds and tree-frogs.

" The whole story suggests the evolution of the mottled *wagleri* from the green *gramineus* as an adaptation for concealment in jungle, but that it still retains the green colouring of the latter in the young; furthermore, that the caterpillar originally mimicked the young of *gramineus* and now also the young of *wagleri*.

" The picture reproduced in the plate was drawn by the Singapore Garden artist, James D'Alwis, a Cinghalese, who also drew the black and red caterpillars surrounding the top of a plant-stem in the Natural History Museum.* I did not see these alive : the drawing was made when I was away. I intended to have more drawings done, but these two were I think the only ones. D'Alwis left in 1894, and this also prevented me from having a picture of the young snake which I had hoped to add to that of its mimic."

Two excellent examples of caterpillars with terrifying eye-like marks, from Malekula, New Hebrides, are figured by Miss Cheesman in *Hunting Insects in the South Seas*, London, 1932. Unluckily they could not be bred successfully, so that the species remain uncertain, but my friend Dr. Karl Jordan considers that they are certainly Noctuidae. The larger of the two, opposite p. 44, he suggests may belong to the genus *Phyllodes* (Catocalinae), of which a species, *P. imperialis*, Butl., occurs in the New Hebrides. The eye-like mark is bright blue which thins away anteriorly and is here bordered with red and this again with a shorter segment of white. The large " pupil " is very dark blue. The Native name for the larva is " Tiavol," which Miss Cheesman suggests may have been formed from " Diable." Dr. Jordan also informs me that there are no Eastern Sphingidae with a larva at all like this, and that its proportions and attitude are those of a Noctuid. The other smaller caterpillar, opposite p. 42, is certainly an *Ophideres* (Catocalinae) of which there are, he believes, several species in the New Hebrides. The display of eye-like marks in the doubled-up attitude of *Ophideres* is well known, and an Indian example, shown to me by the late Lord Walsingham, is figured in *Colours of Animals*, London, 1890, p. 263. Both larvae were painted in April 1929, and the drawing, kindly lent to me by Miss Cheesman, shows that the posterior " eye " of the *Ophideres*, as well as the much larger anterior " eye," possess a small bright blue " pupil " and a brown " iris," ringed with white.

Sexes of *Pyrameis cardui*, L., flying at midnight, between Madeira and Bathurst.

Prof. Poulton, who had now received the twelve examples of *P. cardui* referred to in our *Proceedings* (**7** : 56), reported that they included 4 ♂♂, 8 ♀♀. The sexing of these papered specimens was not very easy, and he was glad that Mr. N. D. Riley had agreed with his conclusions.

* My friend Mr. N. D. Riley has kindly written (15 Dec. 1932) that " The black and red caterpillars surrounding the top of a plant stem, which were illustrated in a drawing exhibited for many years in the Mimicry Case at the foot of the stairs in the Central Hall, were those of *Hypsa monycha*, Cramer. This I have discovered from some old notes. The drawing itself was taken down about five years ago."—E.B.P.

Papers.

The following papers were read :

1. " A catalogue of British Braconidae," by G. T. Lyle.
2. " The Passalidae of the Belgian Congo," by W. D. Hincks.
3. " Studies on Ethiopian Simuliidae," by E. G. Gibbins.
4. " On the types of Oriental Carabidae," by H. E. Andrewes.
5. " Collected records relating to insect migration, III," by C. B. Williams.
6. " Attacks of birds on butterflies," by G. D. Hale Carpenter.
7. " On the biology of Ceroplatinae, etc.," by G. H. Mansbridge.
8. " Two horned Sphingid Larvae," by E. A. Cockayne and C. N. Hawkins.
9. " Two new Malayan Sphecoids," by H. T. Pagden.

ANNUAL MEETING.

Wednesday, January 18th, 1933.

Dr. H. Eltringham, F.R.S., President, in the Chair.

Dr. S. A. Neave, Secretary, read the names of the Fellows nominated as Officers and Council for the ensuing year, and announced that they had been duly elected in accordance with the Bye-Laws.

He then read the following :—

Report of the Council.

In addition to carrying on its normal activities, the year 1932 has been an unusually busy one for the Society in view of the necessary preliminary arrangements for the Centenary Meetings next May and of the production of the first volume of the new journal, *Stylops*.

The details connected with the celebration of the Centenary have been referred to a special Sub-Committee consisting of Professor E. B. Poulton (Chairman), Dr. H. Eltringham, Mr. A. F. Hemming, Mr. R. W. Lloyd, Sir Guy Marshall and Dr. S. A. Neave, and on their recommendation the Council have decided on the following preliminary arrangements :—

The ceremonies themselves will include a formal meeting in the afternoon of Wednesday, 3rd May, for the reception of delegates and addresses, and this will be held at 3 p.m. in the rooms of the Royal Geographical Society, Kensington Gore. There will also be a scientific meeting the same evening. On the evening of 5th May, a reception will be given at Lancaster House by H.M. Government at which Major the Right Hon. Walter Elliot, M.C., M.P., Minister of Agriculture and Fisheries, will receive the guests. Good progress has also been made with the preparation of the Society's history, which it is proposed to distribute to Fellows in April next. A number of contributions have been received to the Centenary Fund, amounting on 31st December to £264 8*s*. 7*d*. from 44 Fellows.

During the summer of 1932 the Fifth International Congress on Entomology was held in Paris at the same time as the celebration of the Centenary of the Société entomologique de France. The Society was represented on both these occasions by its President, Dr. Eltringham, Sir Guy Marshall, and its Secretary, Dr. Neave, an illuminated address of congratulation being presented to the French Society.

Since the last Annual Meeting, 1 Special Life Fellow, Mrs. E. F. Meldola, and the following 15 (8) Fellows have died, or their deaths have been ascertained (the numbers in brackets in this and the following paragraphs indicating the corresponding ones for last year) :—C. T. Bowring, W. J. Holland, D. Johnstone, J. J. Joicey, A. M. Lea, W. J. Lucas, C. Matthews, W. Randall Parkes, R. S. Parris, M. G. L. Perkins, J. C. Robbins, T. G. Sloane, R. South, T. H. Taylor, and R. S. Wilson.

The following 11 (31) Fellows have resigned :—J. Davidson, C. Earle, J. H. Hutchinson, S. S. Light, J. H. B. Lowe, H. Notman, O. C. Ollenbach, J. Peed, F. Russell, G. T. Shaw, and A. E. Tonge (Cheshire).

The following 19 (8) have been removed from the List of Fellows in accordance with the Bye-Laws, Chapter XVI, section 3 :—C. E. Clarke, J. A. Comstock, The Rev. B. Cornford, A. Dutt, A. H. Elston, J. G. M. Gordon, M. H. Hatch, L. B. Hopper, M. Hosny, H. S. Leigh, H. C. Mace, K. Mansour, E. A. D. Marks, T. F. Marriner, H. O. Morgan, L. Paravicini, D. Ponniah, A. Valentine, and S. El Zoheiry.

During the year 1 Special Life Fellow, Col. C. G. Nurse, and 11 Ordinary Fellows have been elected. This does not compensate for the losses during the year, and it is with regret that the Council find themselves unable to report the customary increase in the number of Fellows. The Society now consists of 12 Honorary Fellows, 5 Special Life Fellows, and 655 Ordinary Fellows.

The meetings have again been well attended, the average number of Fellows and Visitors at each being 61, being an increase of 4 over the previous year.

The two Parts of the *Transactions* for 1932 (Vol. 80), were published on 30th June and 31st December respectively. They comprise 16 papers by 16 authors. Of these 5 deal with Lepidoptera, 3 with Hymenoptera, 2 with General Entomology, 1 with Coleoptera, 1 with Diptera, 1 with Neuroptera, 1 with Orthoptera, 1 with Trichoptera and 1 with Insects in relation to Temperature. The volume consists of 441 pages and is illustrated by 28 plates, of which 2 are in colour.

Material assistance from a number of sources has again been received towards the cost of the volume, and the following contributions have been received or promised in respect of it :—The Empire Marketing Board has authorised a substantial contribution towards the cost of the paper by Messrs. Richards and Thompson, Dr. F. Morton Jones defrayed the cost of the coloured plate illustrating his paper, Mr. A. F. Hemming defrayed the cost of the 2 plates illustrating his paper, and Professor Poulton authorised a grant from the Evolution Fund presented in his name to Oxford University by Professor James Mark Baldwin, covering part of the cost of the paper by Dr. F. Morton Jones. Part of the cost of Dr. Carpenter's and Mr. Bristowe's papers was provided by Jesus College, Oxford, out of a grant from Professor Poulton's Fellowship.

The volume of the *Proceedings* will consist of about 140 pages, illustrated by one coloured plate and some few text-figures. The cost of the plate has been paid by a grant authorised by Professor Poulton from the Evolution Fund, presented in his name to Oxford University.

The first volume of *Stylops* consists of 272 pages and is illustrated by 3 plates and numerous text-figures. It comprises 59 papers by 39 authors. Of these 16 deal with Diptera, 13 with Coleoptera, 7 with Lepidoptera, 6 with Hymenoptera, 7 with Rhynchota, 3 with Odonata, 2 with Orthoptera, 2 with Psocoptera, 2 with Trichoptera, and 1 with Thysanoptera.

Mr. Hemming defrayed the entire cost of the plate illustrating his article on Syrian Butterflies and part of the cost of that illustrating his article on Japanese Butterflies, and the Imperial Institute of Entomology paid the cost of the plate illustrating Dr. Hering's article.

The detailed work of the Society's business has been carried on by the Finance Committee, under the Chairmanship of Mr. R. W. Lloyd, the Publication Committee under that of Sir Guy Marshall, and the Library Committee under that of Dr. A. D. Imms, and the thanks of the Council are again due to those Fellows who have served on these Committees.

The Library, both as regards its organisation and the growth of its contents, has continued to make steady progress during the year. The most important single addition is that of 175 volumes and approximately 3500 separates purchased from the library of the late Mr. J. J. Joicey. Considerable progress has been made with the arranging and cataloguing of the great collection of Separata, though there still remains a very large number to be dealt with. The increased use of the Library by Fellows that has been characteristic of recent years still continues. The number of books issued on loan amounted to 1061 (612) borrowed by 348 (295) Fellows. In addition several books not in the Library were obtained for Fellows from the National Central Library, whilst in return a few books were sent on loan to this organisation.

An interesting addition to the Society's collection of portraits, the gift of Mrs. Selwyn Image, is the oil painting known as "The Aurelians" by John Cook, exhibited at the Royal Academy in 1909. This picture, which comprises portraits of the late Dr. Longstaff and of Professor Selwyn Image, is at present hung in the Council Room.

The following changes of staff have been made during the past year. In September Mrs. R. E. James, the Clerical Assistant, resigned, and was replaced by Miss E. Evans in October, and Miss J. Stephens, who had been doing voluntary work in the Library since February, was appointed Library Assistant at the same time.

The Hon. Secretary of the Committee for the Protection of British Insects reports that the Sub-Committee appointed at the request of the Council, to consider the recommendation of the Society's representatives on the condition of Wicken Fen, presented their Report in detail after visiting the Fen. Their recommendations, which proposed the mowing of certain portions of the Sedge Fen in rotation during the summer months, and made other suggestions for the improvement of the Fen from an Entomological standpoint was submitted to the Council.

The Council approved of their suggestions and directed that a copy be sent to the National Trust and also to the Local Committee of Management of Wicken Fen at Cambridge. The report was considered by a sub-committee at Cambridge, which, though in sympathy with the general objects of the recommendations made, did not consider that the restoration of the Fen to that condition in which it was at the close of the last century could be achieved by the cutting programme suggested. At the same time they were prepared to accept a very limited experimental programme of summer cutting in certain areas. They considered that the summer cutting of the droves would result in diminution of herbaceous flowering plants and did not recommend it.

The Protection Committee feel that their recommendations which dealt with both wet and dry areas and different conditions of growth, have not been fully understood, and they are endeavouring to arrange for their sub-committee to meet the Cambridge sub-committee on the Fen, when it is hoped, by the interchange of

views, to arrive at a decision of which the result should be to make Wicken Fen more suitable for Entomological research than is the case at the present time.

A contribution was again made towards the expenses of the reserve for *Lycaena arion* in Cornwall. Unfortunately the Fellow through whom the Committee arranged for this protection was unable to visit the locality during the time the insect was on the wing, so that it is not possible to say if any increase in numbers had taken place.

The Royal Society for the Protection of Birds have made their Reserves on Dungeness a Sanctuary for Insects and Plants as well as for Birds. This will not interfere with collecting on other portions of this area not under their control, but will provide a Sanctuary in which the special insects inhabiting this area can breed unmolested and restock those portions which have become so very popular with Entomologists of recent years.

The Colony of *Chrysophanus dispar batavus* at Wood Walton Fen suffered very heavy loss from a serious flood at the end of May, and a large number of the larvae were drowned, only those larvae surviving that were feeding on docks growing in the higher parts of the Fen. A small batch of pupae which had been bred in confinement by Capt. Purefoy was sent to the Fen to augment the few that were left. The Fen is well stocked again, though it is not intended to go on breeding a number artificially each year but to see now whether this butterfly can survive unaided in this locality.

The Colony at Wicken Fen has been most successful; Wicken was not flooded to the same extent as Wood Walton, and there was an excellent emergence. The watcher reported that on one sunny day he saw over 100 butterflies on the wing.

The Report was adopted on the motion of Prof. W. A. F. Balfour-Browne, seconded by Dr. E. A. Cockayne.

Mr. A. F. Hemming, Treasurer, then read the following

Report of the Treasurer.

The management of institutions like ours that depend for the greater part of their income on subscriptions and on the sale of publications must necessarily be a matter of considerable anxiety in periods of general depression like the present.

In the circumstances, it is not surprising that the statement of income and expenditure now presented shows a considerable shrinkage of income from subscriptions, and a marked falling off in the amount received from the sale of publications. Against this should be noted the substantial economies in expenditure that have been effected without impairing the standard of service given by the Society to its Fellows.

The year just closed was marked by the launching of the Society's new journal *Stylops*, the publication of which had been approved by the Council in the previous year. From the financial point of view, *Stylops* has made a promising start, especially when regard is paid to the financial difficulties of the time. Naturally, however, a venture of this kind cannot be immediately self-supporting. After deducting receipts from sales and sums received as donations, the sum expended on *Stylops* last year from the general funds of the Society amounts to £257 4*s*. 0*d*.

The gross expenditure on the Society's *Transactions* and *Proceedings* was less

than in the previous year, but this is due mainly to the exceptionally large donations received in 1931, notably that given by the Empire Marketing Board towards the cost of the extra part published in that year.

The appropriation from the General Fund towards the upkeep and development of the Library was substantially the same as in 1931.

It is satisfactory to note that the Council have been able to resume the practice of their predecessors by making a substantial annual appropriation to the Repairs to Premises Fund. This had been discontinued during the period in which the Society was carrying through its housing policy, when all available funds were required to meet current expenditure. The maintenance of this policy will ensure that when the time comes to redecorate the Society's premises, the funds required will have been accumulated and there should be no exceptional payments to be made from the General Fund on this account.

The excess of normal income over normal expenditure amounted in 1931 to £352 12*s*. 0*d*., and in 1932 to £52 19*s*. 7*d*. In order, however, to make a fair comparison of the two years, account should be taken of what would have been the position if the Council had not persevered in their intention to begin the publication of their new journal *Stylops*. The net expenditure incurred on *Stylops* amounts, as has already been explained, to £257 4*s*. 0*d*. If, therefore, *Stylops* had not been started, the excess of income over expenditure in 1932 would have been £310 3*s*. 7*d*., a reduction of only £42 8*s*. 5*d*. on the figure of the previous year.

On the whole, this may be regarded as a satisfactory result, but now that the margin between normal income and normal expenditure is so close, it will be more necessary than ever to maintain the strictest watch over the Society's expenditure, with a view to securing every possible economy.

The balance sheet calls for little comment.

The Council received during the year the bequest of £450 (£500 less legacy duty) by the late Professor Meldola, which became payable on the death of his widow. This sum has been credited to the General Reserve.

During the year a Centenary Fund was established. On the 31st December last, subscriptions received from 44 Fellows, with accrued interest thereon, amounted to £264 8*s*. 7*d*.

The excess of liabilities over assets, which on the 31st December, 1931, amounted to £172 3*s*. 2*d*., has been reduced by the excess of income over expenditure for the current year, and now amounts to £119 3*s*. 7*d*. It may be hoped that with careful administration it will be possible to wipe out this figure altogether by the end of the current year.

The Report and Accounts were adopted on the motion of Dr. K. Jordan, F.R.S., seconded by Mr. R. W. Lloyd.

The President then read his address, and at its conclusion a vote of thanks to him, coupled with the request that it might be printed in the *Proceedings*, was moved by Prof. E. B. Poulton, seconded by Mr. H. Willoughby Ellis, and carried unanimously.

A vote of thanks to the Officers for their services during the year was then passed on the motion of Sir T. Hudson Beare, seconded by Mr. R. W. Lloyd, and Dr. S. A. Neave, and Mr. A. F. Hemming briefly replied.

THE ENTOMOLOGICAL SOCIETY OF LONDON.

TREASURER'S STATEMENT OF INCOME AND EXPENDITURE for the Year ended December 31st, 1932.

(Presented at the Annual Meeting, 18th January, 1933.)

GENERAL FUND.

INCOME.

1931.		£	s.	d.	£	s.	d.
£							
	To Subscriptions—						
40	Received in advance for 1932 ...	43	3	7			
1,232	Received in 1932 for 1932... ...	1,157	11	6			
47	Received in 1932 for previous years	39	18	0			
1,319		1,240	13	1			
115	*Less* Subscriptions in arrear at 31st December, 1931	135	0	0			
1,204		1,105	13	1			
135	*Add* Subscriptions in arrear at 31st December, 1932—Valued at ...	50	0	0			
1,339					1,155	13	1
95	,, Admission Fees				44	2	0
	,, Publications—						
691	Sales	479	18	5			
398	Donations towards cost	178	13	9			
1,089					658	12	2
—	,, Interest on Deposit at Bank				2	19	1
55	,, Dividends on Investments (gross) ...				55	2	8
250	,, Rents from Sub-Tenants				250	0	0
	,, Contributions by Sub-Tenants towards						
247	House Expenses				233	3	8
3	,, Hire of Meeting Room					—	
	,, Donation by Dr. R. Stewart MacDougall						
110	for Library Furniture					—	
5	,, Miscellaneous				13	19	3
£3,193					£2,413	11	11

EXPENDITURE.

1931.		£	s.	d.	£	s.	d.
£							
	By House Expenses—						
214	Wages				221	12	5
111	Fuel, Gas and Electric Light ...				94	9	9
46	Insurance and Water				35	9	3
50	Repairs Fund—Transfer				50	0	0
45	Miscellaneous				44	12	9
466					446	4	2
	,, Office—						
550	Salaries				614	17	1
40	Printing and Stationery				66	15	2
30	Postage				26	8	3
21	Audit Fee				21	0	0
19	Superannuation ...	25	5	6			
	Less Employees Contribution	10	10	0			
10							
9					14	15	6
21	Furniture and Equipment ...					—	
20	Miscellaneous				14	17	1
691					758	13	1
	,, Library—						
179	Library Fund Transfer				167	11	6
121	Furniture					—	
300					167	11	6
1,358	,, Cost of Publications				705	19	7
	,, "Stylops" Cost of Printing, &c. ...				355	5	6
	Less Subscriptions ...	90	7	0			
	Donations ...	7	14	6			
					98	1	6
25	,, Donation to Zoological Record ...				257	4	0
	,, Excess of Income over Expenditure				25	0	0
353	carried to Balance Sheet				52	19	7
£3,193					£2,413	11	11

STATEMENT OF INCOME AND EXPENDITURE for the Year ended December 31st, 1932.

WESTWOOD BEQUEST FUND.

1931.	Income.	£ s. d.	1931.	Expenditure.	£ s. d.
£ 7	To Interest on Birmingham Stock	7 3 8	£ 7	By Income for the Year, carried to Balance Sheet	7 3 8

HAMILTON DRUCE BEQUEST FUND.

1931.		£ s. d.	1931.		£ s. d.
£ 44	To Interest on New Zealand Stock	43 16 6	£ 44	By Transfer to Library Fund	43 16 6

LIBRARY FUND.

1931.		£ s. d.	£ s. d.	1931.		£ s. d.	£ s. d.
£ £				£ £			
	To Transfer from Hamilton Druce Bequest Fund—Interest on New Zealand Stock	43 16 6		116	By Expenditure on Books	208 10 2	
44				83	„ Binding, Repairs and Insurance ...	42 4 9	
179	„ Transfer from General Fund	167 11 6		199			250 14 11
8	„ Miscellaneous	1 10 0					
231			212 18 0	32	„ Excess of Income over Expenditure, carried to Balance Sheet		—
—	„ Excess of Expenditure over Income, carried to Balance Sheet		37 16 11				
£231			£250 14 11	£231			£250 14 11

REPAIRS TO PREMISES FUND.

1931.		£ s. d.	1931.		£ s. d.
£			£		
50	To Transfer from General Fund	50 0 0	38	By Expenditure on Repairs	7 0 6
			12	„ Excess of Income over Expenditure, carried to Balance Sheet	42 19 6
£50		£50 0 0	£50		£50 0 0

CENTENARY FUND.

	£ s. d.	£ s. d.		£ s. d.
To Donations	264 3 10		By Receipts for Year carried to Balance Sheet	264 8 7
„ Interest on Deposit	4 9			
		264 8 7		
		£264 8 7		£264 8 7

BALANCE SHEET, December 31st, 1932.

GENERAL FUND.

Liabilities.	£ s. d.	£ s. d.	Assets.	£ s. d.	£ s. d.
To Donations for Specific Purposes unspent	2 11 10		By Sundry Debtors—		
,, Sundry Creditors	575 9 9		Subscriptions valued at	50 0 0	
,, Subscriptions received in advance	52 16 1		Admission Fees	18 18 0	
		630 17 8	Publication Sales	202 7 8	
,, Balance at Bank—overdrawn		43 18 1	Contributions to Cost of Publications	91 10 0	
			Rent and Contributions to House Expenses ...	130 12 4	
			Sundries	42 2 0	
					535 10 0
			,, Payments in advance		13 5 11
			,, Unsold Copies of Publications (not valued)		
			,, Cash In Hand		6 16 3
			,, Excess of Liabilities over Assets—		
			As at 31st December, 1931	172 3 2	
			Less Excess of Income over Expenditure for year to date	52 19 7	
					119 3 7
		£674 15 9			£674 15 9

WESTWOOD BEQUEST FUND.

	£ s. d.	£ s. d.		£ s. d.
To Excess of Assets over Liabilities at 31st December, 1931	250 0 0		By £239 12*s.* 4*d.* Birmingham Corporation 3% Stock 1947 at cost	250 0 0
Add Income from Investment for year to date ...	7 3 8		(Value at date £200 1*s.* 7*d.*)	
		257 3 8	,, Cash at Bank	7 3 8
		£257 3 8		£257 3 8

HAMILTON DRUCE BEQUEST FUND.

	£ s. d.	£ s. d.		£ s. d.
To Excess of Assets over Liabilities at 31st December, 1931 ...	1,000 0 0		By £1,095 15*s.* 6*d.* New Zealand 4% Stock 1943/1963 at cost ... ... (Value at date £1,106 14*s.* 8*d.*)	1,000 0 0
		£1,000 0 0		£1,000 0 0

LIBRARY FUND.

	£ s. d.	£ s. d.		£ s. d.
To Excess of Assets over Liabilities at 31st December, 1931	53 4 0		By Library Furniture and Fittings (Not valued)	
Less Excess of Expenditure over Income for year to date	37 16 11		,, Library Books (Valued at £10,000)	
		15 7 1	,, Cash at Bank	15 7 1
		£15 7 1		£15 7 1

BALANCE SHEET, December 31st, 1932.

REPAIRS TO PREMISES FUND.

Liabilities.	£ s. d.	£ s. d.	Assets.	£ s. d.	£ s. d.
To Excess of Assets over Liabilities at 31st December, 1931	11 10 6		By Cash at Bank		54 10 0
Add Excess of Income over Expenditure for Year to date	42 19 6				
		54 10 0			
		£54 10 0			£54 10 0

HOUSING FUND.

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To Excess of Assets over Liabilities at 31st December, 1931		£13,417 3 4	By Freehold Premises, 41, Queen's Gate, at cost	6,250 0 0	
			,, Cost of New Meeting Room Scheme, ...	7,167 3 4	13,417 3 4
		£13,417 3 4			£13,417 3 4

COMPOUNDING FUND.

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To Excess of Assets over Liabilities at 31st December, 1931 (Representing Estimated Liability of Fund at that date—subject to revision quinquennially.)		1,185 0 0	By £1,354 2*s.* 2*d.* 2½% Consols valued at 6th March, 1929	737 19 9	
			,, £532 3*s.* 5*d.* 4% Consols valued at 6th March, 1929 ... (Value at date £1,568 15*s.* 11*d.*)	447 0 3	1,185 0 0
		£1,185 0 0			£1,185 0 0

CENTENARY FUND.

	£ s. d.	£ s. d.
To Excess of Assets over Liabilities—Receipts for Year to date	264 8 7	By Cash at Bank on Deposit 264 8 7
	£264 8 7	£264 8 7

GENERAL RESERVE.

	£ s. d.	£ s. d.
To Excess of Assets over Liabilities ... ... Bequest by the late Professor R. Meldola (£500 *less* Legacy Duty)	450 0 0	By Cash at Bank on Deposit 450 0 0
	£450 0 0	£450 0 0

(Signed) Francis Hemming *Treasurer.*

We have examined the above Balance Sheets and Accounts with the Books and Vouchers of the Society and certify them to be correct. The Solicitors have certified to us that they hold the deeds of 41, Queen's Gate for safe custody on behalf of the Society, and we have verified the other Investments and Bank Balances.

23, *Queen Victoria Street,*
London, E.C. 4.
12*th January*, 1933.

(Signed) W. B. Keen & Co., *Chartered Accountants.*

THE PRESIDENT'S ADDRESS.

Ladies and Gentlemen,

During the past year our Society has lost by death fifteen Fellows.

C. T. Bowring, who died last autumn, collected in China, and some rare and interesting Chinese species from his collections were presented to the Hope Department by himself, and also by Commander Walker.

Dr. W. J. Holland, Director of the Carnegie Museum, died at Pittsburgh on Dec. 13th at the age of 84. He became a Fellow of our Society in 1887. He was born in Jamaica and was a Pastor of the Presbyterian Church at Pittsburgh in 1874. He derived his early taste for Natural History from his father, with whose collections he amused himself when quite a child, and rapidly developed an interest in Entomology and Ornithology. His artistic abilities were fostered by his mother, who gave him his first lessons in drawing, and he was afterwards a pupil of Gustav Grunewald. Thanks to early training he spoke French and German with the same fluency as his own language. At Amherst he studied Chemistry, Physics, Geology and Astronomy and learnt Japanese from his room mate Neesima. Entering Princeton Theological Seminary in 1871, he devoted himself to the study of Hebrew, Chaldee, and Arabic, and afterwards became Professor of Ancient Languages at the Pennsylvania College for Women. He then travelled in Africa, Asia, and South and Central America. In 1887 he was Naturalist to the U.S. Navy Eclipse Expedition to Japan and went on a similar expedition to West Africa in 1889. In 1891 he was elected Chancellor of the Western University, now the University of Pittsburgh, and in 1898 he was made Director of the new Carnegie Museum. He published the well-known Butterfly Book in 1898, of which some 60,000 copies have been sold. He collaborated with Professor Hatcher in reconstructing the skeleton of the great Dinosaur *Diplodocus*, over 84 feet long, discovered in the Jurassic formation of Wyoming, a reproduction of which is in the Natural History Museum. He possessed a long list of Honorary Degrees and Foreign Orders. America and Science have lost an outstanding personality, and we must derive such consolation as we can from the fact that he lived to achieve greatness and was not untimely cut off.

D. C. Johnstone, who died on Feb. 17th, became a Fellow in 1920. Never very robust, his death occurred at the comparatively early age of 42. He was a successful collector of Lepidoptera and was also keenly interested in Ornithology. All who knew him appreciated his generous and unselfish nature, and his loss is deplored by a large circle of friends.

By the death of James J. Joicey, Entomology has lost one of the most lavish patrons this country has ever possessed. His determination to establish a museum came somewhat late in life and began with the acquisition of the Grose-Smith and Druce Collections. Eight well-known collections, rich in types, followed, and his cabinets were rapidly enriched by professional collectors dispatched by him to various tropical areas. Some 900 other collections great and small were ultimately acquired and, including large numbers presented to the British Museum, nearly half a million specimens must have come into his possession. The more valuable part of these great collections has already been set aside for the British Museum, and it is greatly to be hoped that this will ultimately form part of the National Collection.

A. M. Lea was a well-known Australian Entomologist who became one of our Fellows in 1899. His publications on the Coleoptera of the Australian region form an invaluable contribution to our knowledge of the order. He was formerly Government Entomologist of Tasmania, and in 1911 was appointed Government Entomologist of South Australia, holding that office up to the time of his death. His knowledge of Australian insects made him a centre of inquiry from Entomologists all over the world, and he described between 5000 and 6000 species. His death is an irreparable loss to Entomology.

W. J. Lucas died on Jan. 5th of last year. He became a Fellow of our Society in 1898. After taking his degree at London University in 1887 he became Senior Mathematics and Science Master at Tiffins School, Kingston-on-Thames, and was Lecturer on Nature Study to the Surrey County Council. He had the great gift of imparting knowledge, and his career as a teacher was one of outstanding success. In 1900 he was President of the South London Society and he served on our Council from 1904 to 1906. He was a prolific writer on Entomological subjects and published valuable work on Odonata, Orthoptera, Neuroptera, and other orders. The illustrations accompanying his works are a monument to his great artistic skill. An apparent shyness of disposition barely concealed a singularly lovable personality, and his death is a serious loss to very many of us personally as well as to Entomology in general.

Corydon Matthews died in April. He was, I believe, primarily an Ornithologist.

Mrs. Meldola died on Jan. 2nd of last year. She was one of our Special Life Fellows and was always intensely interested in the Entomological work of her late husband, Professor Meldola. She presented to the Society a copy of the rare first edition of Belt's *Naturalist in Nicaragua*. She captured and presented to the Hope Department the *Xanthorhoë fluctuata*, ab. *geomella*, figured in our Transactions for 1928.

W. R. Parkes died on Feb. 11th, after a short illness, at the early age of 27, on the threshold of a promising medical career. He had already shown a keen interest in Lepidoptera and Orthoptera.

R. S. Parris died in February. I have been unable to secure any particulars of his Entomological work.

Dr. M. G. L. Perkins died in March at the early age of 33. He was Huxley Prizeman at King's College, London, and a Senior Scholar of Trinity College, Cambridge. He joined the Westminster Hospital Medical School in 1927 and took the degree of Doctor of Philosophy in 1930. He took a keen interest in Natural History. He published work on the Coleoptera of Wicken Fen, on Cambridge Planarians, and a key to the Crabs of Britain and the N.E. Atlantic. He did considerable work on the Platyhelminthine Worms, was interested in the problems of Parasitism and the respiratory metabolism of Bats. He was perhaps a little too versatile, and his work suffered to some extent from lack of concentration, but there is little doubt that he would have settled down to valuable research as his tastes became more matured. He was a most charming companion with a ready wit and a wide knowledge of an amazing range of subjects. His early death was a great shock to his many friends.

J. C. Robbins. As in the case of W. R. Parkes and of Dr. Perkins, it is especially sad to have to record the death of one of our very young colleagues. A life full of promise is cut short and we feel unjustly deprived of friendships and abilities which we should by right have enjoyed. John Robbins was a valued member of the Staff of the Imperial Institute of Entomology and at the time of his death was working at the Farnham Royal Laboratory. He was killed in an accident on the way to his work. He was on the eve of departure on an expedition to South America in connection with Entomological Research in the West Indies. A most attractive personality, he was deservedly popular with a large circle of friends.

T. G. Sloane died on Oct. 20th. In the spare time snatched from his business of sheep-farming he devoted himself whole-heartedly to Natural History. He was regarded as the Australian authority on the Carabidae and published papers on their classification and on the Faunal Subregions of Australia. He was responsible for over sixty papers and described nearly 600 species. He was esteemed by those who knew him as a delightful companion and a lovable friend.

Richard South died in his 86th year and was elected a Fellow of our Society in 1885. His interests were mainly with the Lepidoptera, and few of us, young and old alike, are not indebted to his excellent little volumes on the Butterflies and Moths of the British Isles. For some 25 years he was editor of the *Entomologist* and gave valuable advice and support to his successors in that office. He was Curator of the Leech Collections and worked for some years at the Natural History Museum on Leech's British collections and on other Lepidoptera. He was especially familiar with Lynton, Dorset, and the New Forest.

T. H. Taylor, who died in November, was at one time Demonstrator in Biology at the Yorkshire College, Leeds, then Assistant Lecturer and Demonstrator in Zoology, and finally Lecturer in Agricultural Zoology and Advisory Entomologist to the University of Leeds. His patience and enthusiasm in teaching and his careful Entomological work earned for him the highest esteem of his associates.

I will ask you to rise for a moment in respect for the memory of our colleagues.

When, a year ago, I had the honour of addressing this Society, I endeavoured to deal with our Science in somewhat general terms, briefly summarising the

academic interest and the practical applications of Entomology. My remarks on that occasion were intended quite as much for the layman as for the expert, and judging by some of the kindly appreciations I have received, my efforts were not altogether unsuccessful. To attempt a second address on similar lines would scarcely be possible even if it were expedient, and I have therefore been faced with the problem of selecting a subject which, though less generalised, might yet prove of interest to as large a proportion as possible of my audience. It occurred to me that the Senses of Insects might prove an acceptable theme, the more so, if interest and experiment in a subject concerning which so much still remains to be discovered, might thereby be stimulated.

The study is one to be approached with considerable care. In the earlier days of Entomological study, many workers seemed unable to dissociate the supposed senses of insects, not merely from human psychology, but also from human, or at least vertebrate, morphology. As Forel has pointed out, when authors maintain that a damp mucous membrane is necessary to an olfactory sense, they merely assert, without any supporting evidence, that the structure of a vertebrate organ is the only possible one for that particular function. As well maintain that because an insect has no lungs, therefore it cannot breathe.

Whilst we may feel satisfied that we have readjusted our mental attitude sufficiently to avoid the limitations of the morphological obsession, we find it less easy to control those of our psychological outlook. We try to find in insects the equivalents of the senses we ourselves possess. There seems to be no fundamental error in taking this as our starting-point, provided we use it as a comparative rather than an absolute conception. Our own senses enable us to regulate our mental and physical communications with the outside world. Like other animals, the insects must have similar or at least equivalent faculties, limited, and to some extent controlled though they may be, by the requirements of a sequence of stereotyped activities, and responding to external influences, almost entirely by subconscious reaction rather than by intelligent reason and conscious purpose.

We usually ascribe to ourselves the five senses of sight, hearing, taste, touch, and smell, and most of our conscious impressions can be roughly assigned to the five categories mentioned. One might with reason argue that hearing and a sense of musical tone are not necessarily the same, and since Beethoven wrote music after he became totally deaf, the former seems not to be a necessary basis of the latter. Nor does sight, as such, necessarily imply the faculty of correct colour vision, or even any colour vision at all, though purely monochromatic vision in human beings is of the greatest rarity. A very important sense, though limited in scope, is that of equilibrium. Although this sense happens in our own case to be associated with the inner mechanism of the ear, it is not part of our hearing faculty, and the apparent coexistence of static control and an auditory apparatus in an insect need not imply that both faculties are to be attributed to the same organ or position. Furthermore, we must remember that the nervous system of an insect differs widely from that of a vertebrate. In ourselves the brain is the central exchange which receives and answers the infinitely complex messages with which it has to deal. An electric telegraph which receives and transmits a number of separate messages simultaneously along the same conductor is a human invention at which we may well marvel, but the response by our central nervous system to minute and multiple stimuli can perhaps best be

appreciated when we contemplate the performances of a Paderewski, a Cinquevalli, or a Lindrum.

Certainly the insect has a brain, but it is not fully comparable with that of the vertebrate. Its responsibility is partly delegated to a series of ganglia, or substations, roughly corresponding with the segments of the creature's body. Even a vertebrate animal such as a frog will perform coördinated and purposeful movements after the brain is no longer in spinal communication with the rest of the body. The removal of the entire head of an insect neither kills it immediately, nor inhibits many of its thoracic and abdominal activities. In conjunction with the suboesophageal ganglion the insect's brain has some influence over the coördination of the body movements. According to Loeb, removal of one side of the brain causes circular movements. The suboesophageal ganglion seems of importance in the maintenance of life, since, provided this is intact, the insect may live for months without the rest of the brain. Packard observes that a decapitated insect will continue to clean its legs and wings. The thoracic ganglia control the movements of their respective segments, and there is good evidence that in all the somatic ganglia the dorsal lobe is motor, and the ventral sensory, in function. Plateau found that each ganglion of the ventral nerve cord is a respiratory centre for its own segment.

In searching for some common basis from which to compare insect senses with our own we should, I think, guard against the assumption that our own actions are always the result of reason and conscious purpose. Subconscious actions are more frequent in ourselves than is generally recognised. They play an all-important rôle in any activity which implies skill. Proficiency in any mental or physical performance is acquired only through the training of many actions, both mental and physical, which grow in efficiency in proportion as they become subconscious, and while the insect inherits its subconscious ability to perform the few, if sometimes highly complicated, activities necessary for its survival, we have to learn individually. All that we inherit, if we are fortunate enough to do so, is the mental and physical equipment which enables us to acquire our varied accomplishments.

Bearing these considerations in mind we may approach the subject of insect senses, and attempt to estimate at least their analogies with our own. We may say that an insect can see, without committing ourselves to any positive assertion as to what it can perceive. It may hear in the sense of being affected by aerial vibrations without our claiming that it analyses sounds or derives any conscious impression from them. It may have a chemical sense, either through a gaseous or fluid medium, corresponding with our senses of smell and taste, without having any aesthetic appreciation of the agreeableness or otherwise of the odours or tastes involved. Its tactile sense may arouse automatic responses without any psychic accompaniment.

For myself I am inclined to favour a slightly higher conception of insect senses than that of pure automatism. Many insects are so highly organised that I feel compelled to credit them with faculties at least in some degree more advanced than mere unconscious responses to unperceived stimuli. Though the insect seems almost insensible to pain in any sense in which we understand the word, there is, I think, ample evidence that it is not entirely unconscious of the two most primitive stimuli of living organisms, sex and food. Sexual excitement is quite obvious in many insects, and whilst food may be quite secondary, since many imaginal insects do not

feed at all, I cannot persuade myself that the butterflies in the general assembly on the *Buddleia* in my garden are not deriving, from the taste and scent of the nectar, something more than the mere unconscious satisfaction of an unperceived but stimulating appetite. Let us then proceed to consider in more coldly anatomic fashion the forms and apparent functions of some organs to which we may with certainty or probability attribute sensory functions.

Perhaps the only insect sense organs whose functions we can regard quite certainly as analogous if not homologous with our own are the eyes, though these organs vary slightly in number and very considerably in structure and efficiency. Simple eyes have one lens and to that extent are similar to the eyes of vertebrates. They may occur either with or without the accompaniment of compound eyes in the same individual. The simple eye usually consists of a comparatively large plano-convex or double convex lens, by which such rays of light as fall within its range are concentrated on to a rather primitive retina composed of a comparatively small number of nervous elements. Speculation on the degree of usefulness of such an eye has been as extensive as its conclusions have been indecisive. In larval forms such eyes are commonly found in groups, as in the usual set of six on each side of the head of a Lepidopterous larva. Their cerebral connections are branches of a single nerve. The form of lens provided must give a small inverted image, but the value of six small inverted images of scattered portions of a diverse field of view seems so problematical that we must conclude that the organ is a mere light-perceptor, and the behaviour of insects having this arrangement of eyes would seem to confirm that view.

The lateral ocelli of Neuropterous, Coleopterous, and Lepidopterous larvae have a lenticular thickening of the cuticle, beneath which there lies a crystalline body, consisting of three cells joined in the central axis. The visual cells are usually arranged in two crowns, the distal crown having three cells and the proximal four.

In Chironomid and Culicid larvae the ocelli are of the simplest possible form, being composed of a few sense cells of which the distal ends lie in a pigmented cup of the cuticle. In many adult insects, however, we find these simple eyes large and highly developed. A wasp with its three ocelli, two lateral and one median, must have some use for such organs. The two ocelli of the Gamma Moth lie adjacent to the compound eyes, and each consists externally of a brilliant lens, surrounded by a fringe of radially placed setae whose function is quite evidently to prevent obstruction of the view by the long scales with which the head is so plentifully adorned.

Still further complexity is found in the ocellus of the Dragon-fly (*Agrion*). The lens is a laminated structure lying in a cup of pigmented cells, and this layer is continued round the sides and proximal parts of the visual cells. These visual cells are unpigmented and are arranged in two layers. Those of the outer layer are distally expanded into cone-shaped extremities, bearing a marked resemblance to the cones of compound eyes. Those of the proximal layer are more or less blunt and flattened externally. Each cone of the distal layer is formed of three cells joined in the central axis where they form a small rhabdom or stiffening rod. The proximal layer of visual cells is embedded in a refractive mass forming a tapetum to which I shall refer later. This curious arrangement of a double layer of visual cells occurs in simple and intermediate forms of eye. Hesse suggests that they form what may be termed a double retina, the outer perceiving distant, and the inner nearer objects,

though it is difficult to understand how this could occur in an eye of such a pattern. However that may be, the ocellus of *Agrion* must be something much more than a mere light perceptor, and may well be credited with true, if somewhat coarse visual powers. Interesting and varied as are the ocelli we must pass on to those extremely complex organs, the compound or faceted eyes. Of these there are four principal types.

The eucone eye, in which there lies beneath each corneal lens a transparent highly refractive body, the crystalline cone.

The pseudocone eye, in which there is a cone-shaped body, of little refractive power and of a fluid or semi-fluid consistency.

The exocone eye, in which there is a cone-like formation of high refractive power, but which, instead of being a structure of independent origin, is really a proximally directed process of the corneal lens itself, and,

The acone eye, in which there is no cone at all.

Eucone eyes may be further divided into two sub-types. Those in which the retinulae or visual cells extend outwards to, or almost to, the apices of the cones, and those in which they stop short at some distance from the cones, the intervening space being occupied by a transparent medium.

I propose briefly to describe the structure of these forms of compound eye and afterwards to discuss their function. Of the first sub-type of eucone eye, that of a butterfly is a good example. Each element of the eye consists, first, of the corneal lens or facet. Beneath this there is a layer of transparent substance separating the lens from the cone. It contains four nuclei representing the so-called Semper cells. True cones are supposed to be secreted by the Semper cells, but in exocone eyes these cells are modified for a quite different purpose.

The cone is a hard transparent body formed of four cells, joined in the central axis, and reduced almost to a point proximally, where it is extended into the depth of the eye as a long transparent rod, the rhabdom. Packed round this rod is a bundle of visual cells, the retinulae. The number of these is rather variable. There is reason to suppose that the primitive number is eight, though in many species we can count only six. Each visual cell tapers off proximally into a fine nerve fibre, and all the nerve fibres pass through a basal membrane into the external optic ganglion. The transparent rod, or rhabdom, in the centre of the bundle stops short of the basal membrane and rests on a funnel-shaped chitinous cup, the tracheal distributor, from the edge of which there arise fine tracheae, supplying the visual nerves. The cone lies in a kind of sleeve or cup formed of pigment cells. These isolate each cone from its neighbours, and absorb all light rays not falling nearly perpendicularly on the corneal facet. In this type of eye the light entering a particular facet cannot affect any of the visual nerves except those immediately beneath it. The whole element, lens, cone, rhabdom, and retinulae, is known as an ommatidium. Of these independent elements or ommatidia there may be 5000 or more in each eye of a butterfly.

In the second sub-type of eucone eye the retinulae do not reach the apices of the cones. There is a considerable intervening space occupied by a transparent medium. Moreover, the pigment cells surrounding the cone are capable of expansion and contraction. A section of such an eye made from an insect which has been kept for some time in darkness shows the pigment sleeve contracted forwards and exposing

an appreciable part of the apical area of the cone, whereas if the insect has been killed in a bright light, the pigment extends backwards almost to the apex. Evidently we have here an adjustable apparatus somewhat analogous with that of the iris of the vertebrate eye.

The pseudocone eye is, so far as I am aware, always of the type in which the retinulae extend outwards to the cone apices, and there is good reason on optical grounds for supposing that this must always be so. So far as concerns the structure the only difference is in the nature of the cones, which are of a soft consistency and poor refractive power. This difference, however, involves a profound modification of the method of image formation.

The exocone eye appears at first, in section, to be very similar to a eucone eye with the retinulae not extending to the cone apices. As Kirchhoffer has pointed out, however, there is no true cone, in the sense of a structure independent of the corneal lens, but the corneal lens is itself produced inwardly to form a cylindro-conical refractive body, not produced into a rhabdom. The visual cells end some distance beneath it and the intervening space is occupied partly by a great extension of the Semper cells.

In the acone eye, such as that of *Tipula*, there is neither cone nor pseudocone. The position usually occupied by these bodies is filled by a group of small transparent cells surrounded by a collar of pigment.

With such a variety of visual organs, how does an insect see? The classical demonstration of the image formation in a compound eye was given by Exner. He experimented first with the eye of *Hydrophilus piceus*, a eucone eye, and found that the cone is possessed of very peculiar optical properties. He was able to show that the refractive index decreases from the centre to the periphery, and described it as virtually a lens cylinder. He pointed out that a lens cylinder of which the length is equal to its focal length would give an inverted image like that of an ordinary lens, but that the more central rays entering it would leave it, not divergent, as with an ordinary lens, but parallel. If the length were twice its focal length the inverted image would be in the middle of the lens cylinder, and would be reinverted, and so erected at its base. On the assumption that the lens and cone of the eucone eye together act as a lens cylinder of twice its own focal length, he prophesied the appearance of an erect image at the apex of the cone. Still using the Water-beetle's eye he failed to demonstrate this image, since he was unable to remove the retinulae and other soft parts, without at the same time detaching the cones from the corneal lenses. He could not dissect the camera without damaging its optical equipment. Perseverance was, however, ultimately rewarded by the discovery that the cones and corneal lenses in the eye of the Glow-worm adhered so firmly together that he could dissect out, without damage, the purely optical part of the eye. This he mounted with a drop of dilute glycerine of the same refractive index as that of beetle blood, and, focussing down with a medium power objective, towards the apices of the cones, he saw a perfect erect image of objects in front of the cornea. It was not a multiple image but a single erect picture made up of all the elements of the whole field of view in their proper order and position. Not only did he see it, but he photographed it. I have several times repeated Exner's experiments and a photograph taken by using the Glow-worm's eye as a lens will be found, rather defectively reproduced, in our Transactions for 1919.

Now comes a curious discovery. Exner regarded the Glow-worm's eye as a eucone eye. The fact that its cones and corneal lenses adhered so firmly together does not seem to have suggested to him anything but a fortunate peculiarity. Kirchhoffer published his work on the eyes of beetles in 1908. It has taken us 24 years to recognise that the only type of compound eye in which the image has been completely and satisfactorily demonstrated is not a eucone eye at all, but an exocone eye. The Glow-worm's eye has no cones in the true sense, what appears to be a cone being merely a process of the corneal lens. From Kirchhoffer's drawings it seems to have several other peculiarities which we have not time to discuss here. The discovery is perhaps no longer of more than academic interest, since there is now good reason to suppose that the image formation in the true eucone eye is of much the same nature, meanwhile we must return for a moment to Exner. The iris-like movement of the pigment remained to be accounted for, and he showed that in a bright light the expansion of the pigment sleeves round the cones would cut off all but the most centrally placed rays, so that each set of visual cells would be stimulated only by the light transmitted through its own corneal facet. This he called the apposition image. In reduced light, however, some of the less parallel rays would, owing to the receding of the pigment, be able to stimulate visual cells adjacent to those of their own facet. There would thus be an overlapping of the light rays, and the insect would use a larger amount of the available light. This he called the superposition image. It would be difficult to devise an experiment to prove this action, but the whole structure of the eye in crepuscular and nocturnal insects supports the theory. We have then, in the exocone eye, a dioptric apparatus capable of producing a good erect image. We can only suppose that so complete an equipment has not been developed without a corresponding efficiency in the nervous mechanism provided for its reception.

Whilst the image formation in the eucone eye cannot be demonstrated so completely as in the exocone form, there is good reason to suppose that it is of a similar kind. In my paper on Butterfly vision, published in our Transactions for 1919, I showed that by suitable methods a small erect image could be seen at the apex of each cone in the eye of a butterfly, and I suggested a theory of the image formation and reception, for which perhaps the most that can be said is that it has not yet been disproved. The presence of the image implies that the lens and cone together act in the same way as the dioptric apparatus of the exocone eye, but the transmission of the image to the retinal elements seems to be of a different kind. The cone is continued into the depth of the eye as a transparent rod or rhabdom, and in this eye the rhabdom would appear to be an essential part of the dioptric apparatus. It is in physiological continuity with the visual cells, and the rays forming the image can pass down it, and can stimulate the retinulae throughout their entire length, instead of merely on the distal ends as in the Glow-worm. There should also be a more perfect analysis of the image by the six or more retinulae clustered round the rhabdom. Eucone eyes in which the retinulae extend to the cone apices are characteristic of diurnal insects. There is no iris-like adjustment to the intensity of the light, and there can be no superposition image. In the eucone eyes of crepuscular insects there is always a space between the cone apices and the distal ends of the retinulae, and the pigment is movable, thus providing for the formation of a superposition image. It may be pointed out that the more central rays from each facet

will stimulate the whole length of the retinulae, whilst the superposed rays from other facets can only stimulate their distal ends. This is probably true, but as the central rays only come from one facet and the superposed rays from several, the stimulation is probably fairly equally balanced.

Vision with the faceted eye may be quite good at close quarters, but its acuity depends on the number of facets within whose field the object lies, and as this varies inversely as the square of the distance, insects must be very short-sighted. I calculated, and, in the paper referred to, endeavoured to illustrate, the distance at which one butterfly should be recognisably visible to another, and the results agreed well with their observed behaviour in nature.

Let us now consider the pseudocone eye. Here the cone has little refractive power. It cannot reinvert the image or even pass it on unaltered. The image formed by the corneal lens is therefore useless as such, and all that appears at the cone apex is a spot of light of the average value of that part of the field of view covered by the lens. How then can an image be formed?

We have only to look at a half-tone illustration to see that a picture can be formed of black dots, so large as almost to touch in the shadows, and so small as to leave considerable spaces in the high lights. If a picture can be formed of different-sized dots it can also be formed, even more perfectly, by dots of differing intensity, and this seems to be the nature of the image in the pseudocone eye. It must obviously be an apposition image, since superposition would destroy it, and I know of no pseudocone eye in which there is a clear space between the cone-apices and the retinulae.

An interesting feature of this method of image formation is the obvious fact that it requires no focal mechanism, the clarity of the image being entirely dependent on the number of facets engaged. Vigier in 1914 published a description, without illustrations, of a supposed focal apparatus in a compound eye. He claimed to have found, between the retinulae, striated muscle-fibres, so arranged as to provide for variations in the length of the retinulae, combined with an adjustment of the curvature of the corneal surface. Apart from the fact that modifications of the curvature of the corneal surface would not affect the focus of a compound eye, though it might alter the extent of the visual field, he was unfortunate in using for his research the eye of a Dragon-fly. Since this is a pseudocone eye, producing what we may call the " half-tone " type of image, a focal apparatus would be of no use to it, and we can only conclude that the author must have been mistaken in his interpretation of the sections at his disposal.

The absence of any focal adjustment in the eucone eye is more difficult to account for. Even if a focal apparatus were present it could only be of use at a certain optimum distance the clarity of the image being mainly dependent on the number of facets engaged.

Of the acone eye I have little to say. The group of transparent, or crystal-cells, which occupy the position of the cones in other eyes may serve to concentrate the light and the eye may work on a principle very similar to that of the pseudocone eye. In the Tipulid eye, each retinula has a small rhabdom of its own, but this would appear to be more in the nature of a supporting structure than a part of the dioptric apparatus.

The great majority of compound eyes can be referred to one or other of the

types described, but there are exceptions. The eyes of *Lepisma saccharina* seem almost intermediate between simple and compound eyes. There are twelve on each side and the bi-convex lenses have convergent axes. Beneath each lens is a transparent body formed of four cells, and considered to be homologous with the cones of the higher forms. There are two layers of visual cells, four above and three below.

A very remarkable form of eye is that of *Scarabaeus variculosus*, apparently a eucone eye, but the "cone" is of the shape of an hour-glass. It is difficult to estimate the refractive action of so curious a dioptric apparatus.

Apart from the peculiarities of the internal structure of the compound eye, there are certain interesting modifications of its external form, one of the most curious being that of *Cloëon*, which has an anterior eye elevated on a pillar-like outgrowth of the head, and a posterior eye normally placed. Moreover, the anterior eye is of the form in which the distal ends of the retinulae do not reach the cone apices, thus resembling the eye of a moth, whilst in the posterior eye they extend right up to the cones and thus resemble the eye of a butterfly.

A peculiar feature of the eyes of many nocturnal and crepuscular insects is the tapetum, a structure which also occurs in some ocelli. I have already mentioned the tracheal supply to the retinulae, but in the eyes of many moths the mass of tracheae surrounding the visual cells seems out of all proportion to the requirements of respiration. If we project a strong light on to the head of a moth which has previously been in darkness, its eyes are seen to shine with a golden or reddish glow. This is caused by the reflection of the light from the air-filled tracheal tubes in which the visual cells are embedded. If the external illumination be continued the glow rapidly disappears, and the cause of this is the expansion of the pigment cells under the influence of the light. The apices of the cones are quickly covered and the admission and reflection of the light reduced. It has been suggested that this reflecting apparatus is of service to a creature which has to make the most of a rather poor light, by throwing the light back again through the eye and so stimulating the visual cells twice over. It is difficult to imagine how this can occur without blurring or destroying the image, and yet the explanation is not without support from the analogy of some vertebrate eyes. Those of nocturnal mammals and some birds reflect light from the *tapetum lucidum*, which is a reflecting layer at the back of the eye, owing its properties to the presence of minute crystals of guanin. Curiously enough some fish scales owe their glitter to the same substance. Though the reflection in insect eyes is generally caused by air-filled tracheae, Hesse claims to have observed minute crystals in the tapetum of the ocellus of *Cloëon*.

From the foregoing brief summary we may conclude that the eucone eye of an insect, such as a butterfly or moth, is, for its size, the most efficient type of compound eye. It is true that the power of sight seems to be greatest in the large Dragonflies, which have pseudocone eyes, but in these the greater size and far more numerous facets would account for their superiority. The relative size of eyes is a consideration which has scarcely received the attention it deserves. As Professor J. B. S. Haldane has pointed out, in reference to vertebrate eyes, these organs are rather inefficient until they reach an optimum size. The nervous elements have a diameter of little more than a length of an average light wave. With fewer but larger nerve-

endings we should see less distinctly, since if they were twice as broad, two points would have to be twice as far apart before they could be distinguished. If their size were diminished and their number increased we should see no better, since it is impossible to form a definite image smaller than a wave-length of light. A mouse's eye is not a small-scale model of a human eye. Its nerve-endings are not much smaller and therefore far fewer. It would probably not be able to distinguish one human face from another at a distance of six feet. In order to be of much use, the eyes of small animals must be larger in proportion to their bodies than are our own. On the other hand, large animals require relatively only small eyes, and those of the whale and elephant are little larger than our own.

We thus see that a butterfly's eye constructed on the same plan as that of a vertebrate would not necessarily be any better adapted to its purpose, perhaps not even so well. Anthropomorphic comparisons are to be avoided, but whilst a Dragon-fly's eye with possibly some 120,000 nerve-endings would seem to be well equipped, we can realise how little ground for comparison exists when we recall that the most recent estimates of the number of nerve-endings in the human eye are of the order of 137,000,000.

I have not time to dwell on the further performances of the compound eye. Its power, in some species of distinguishing colour, has been the subject of much controversy. The conclusions of Hess, who claimed that all insects are colour-blind, have not been supported by more recent research. In my paper already referred to I described experiments which tended to show that many butterflies can certainly distinguish between at least some of the light waves which give rise in ourselves to the sensations we call colour. The majority of experiments of this kind have been made with bees, but the remarkable topographical memory of these insects introduces a disturbing factor. Nevertheless, we are justified in claiming that many insects have a colour faculty in the sense of being able to distinguish something more than mere luminosity values.

I have given perhaps an undue share of our time to the consideration of the sense of sight, but it is almost the only sense in insects of which we have any extensive knowledge.

The sense of touch in insects is, as we all know, very highly developed, even more so in fact than is generally recognised. The more active forms respond with great rapidity to the slightest vibration, and in most species almost the whole body is sensitive to tactile stimuli. Very hard cuticle is sometimes comparatively insensitive, as also is membranous tissue, and Forel states that he has cut across the wings of wasps without their taking any notice of the operation. It is further of interest to note that the tactile sense is discriminative. An insect that will drop to the ground on being touched in an unfamiliar way will pay no attention to natural contacts. Temperature stimuli are also perceived and may induce responses of much the same character as in other animals. There is little doubt that the tactile sense lies in the sensory hairs with which insects are so plentifully provided. These hairs or setae are tubes formed from outgrowths of the cuticle. Usually the base of the hair rests on a membranous ring providing a certain flexibility. The sense-hair probably represents the primitive form of sense-organ, and consists of three cells—the sense-cell with its terminal nerve extending to the base of the hair, the trichogenic cell surrounding it and often showing a vacuole, and the hair-

membrane cell. It would seem that these three cells are the origin of the sense-cell, enveloping cell and cap-cell so typical of the peculiar organ known as a scolopale and found in chordotonal organs. Many modifications of these comparatively simple sensillae are known, and it is almost impossible to draw a dividing line between those which are purely tactile and others which may have assumed, partially or completely, some other function. Sometimes the walls of the hair are very thin and the nerve extends to the outer extremity. This form is generally considered to be chemo-receptive rather than tactile. Freiling has described Lepidopterous scales having nerve connections, and Vogel has also observed them, usually on the veins. On the cerci of the mole-cricket there are claviform sensory hairs, each being set in a ridged alveolus of the chitin.

If we cannot, as yet, clearly define the organs of touch there can be no doubt of the great importance of that sense in insects. The complex constructional and domestic activities of the social insects, usually performed in darkness, must be largely dependent upon it. The same faculty is observed in caterpillars both when feeding and in the construction of their cocoons, in the arrangement of the perfectly ordered clusters of eggs of such insects as the Lackey moth or of some Mosquitoes. In flying, tactile impressions may have static, orientating, or even barometric functions.

The larvae of some Limacodid moths furnish a curious example of the tactile sense associated with a special form of defence. On the near approach of a possible enemy they move in such a way as to turn their batteries of poison spines in the direction of the expected attack. There is, however, in these clusters of spines a delicate hair or hairs of considerable length and so fine as to be almost invisible. Contact with the extremity of this induces the appropriate movement of the creature's body.

Amongst the many forms of sensillae those known as scolophores and containing scolopales, or sense-rods, are specially interesting. A typical scolophore consists of a cap-cell, often extended to form a strand, or ligament, attaching the sensilla to the cuticle. In the proximal part of the cap-cell is embedded the distal end of a second structure known as the enveloping cell. Embedded in this again is the nerve-cell. The end of the nerve-cell here forms a delicate tube, often expanded into a small vacuole, and then again reduced to form a little chamber, whose sides are supported by stiffening ribs. In this chamber there is an exceedingly delicate thread, usually with a small expansion at its distal end, called the apical body. The thread and its apical body seem free to vibrate in the ribbed chamber. This type of nerve-ending is the scolopale or sense-rod. Sense-rods of either a primitive or elaborate kind are found in many forms of sensillae and also in internal situations. Organs containing groups of sense-rods are commonly called chordotonal organs, and the term has become so general that it is convenient to retain it. At the same time the name suggests an auditory function, which cannot by any means be ascribed to all chordotonal organs.

Organs to which auditory functions can with reasonable probability be ascribed, consist of chordotonal sensillae associated with a membrane or tympanum. The best known and most elaborate are those in the fore-tibiae of Tettigoniidae, and Schwabe's beautiful illustration is known to most Entomologists. Two large tympanal cavities open through slits in the exterior of the tibia, and the large

central trachea beneath the membrane bears sub-genual, intermediate, and tympanal organs, all provided with a large number of chordotonal sensillae. They are supplied partly by the crural nerve and partly by a special tympanal nerve, both arising from the ventral ganglion of the first thoracic segment. If auditory organs exist at all we should certainly expect to find them in insects which themselves produce sounds, a condition amply fulfilled in the Tettigoniids. The Cicada, however, one of the noisiest of insects, for long proved something of a problem till Vogel showed that both sexes have tympanal organs, what was formerly supposed to be a resonator of the sound organ being provided with some 1500 chordotonal sensillae.

It is less easy to account for the presence of tympanal organs in insects which, so far as we are able to perceive, do not themselves produce sounds. Such organs are present in many moths, and in our Transactions for 1923 I described the structure in the beautiful Madagascar moth, *Chrysiridia ripheus*. It lies in the second abdominal segment and is not quite the same in the two sexes. There is a tympanum supplied by a delicate nerve containing two scolophores. For one curious feature of these organs there is no explanation at present forthcoming. One end of the scolopales stains more darkly than the other, and this dark portion is distal in the male and proximal in the female, as though their respective positions were reversed. The tympanal organ is in the thorax of Noctuid moths and in the abdomen of Geometrids. If we examine a Geometrid under a moderate power, there may be seen a small opening on the side of the abdomen close to its junction with the thorax. On dissecting out the parts we find that there are two hemispherical vesicles, rather like kettle-drums, symmetrically placed with the drum or tympanum facing forwards and slightly outwards. Each has a piece cut off the edge, leaving an opening bounded partly by the drum and partly by the " kettle," and this forms the external orifice already referred to. What, for descriptive purposes, may be called the cut edge of the drum, is bounded by a chitinised margin, from the middle of which arises a chitinised arch, forming a little curved bridge, the other end of which is attached to the opposite edge of the drum. From the centre of this bridge there depends a nerve, attached to the drum and containing two scolopales. The straight chitinous margin or chord of the drum has upon it fine muscle fibres, apparently for regulating the tension. We must suppose an apparatus of this kind to be capable in some way of detecting aerial vibrations, but with only two sensitive nerve-endings its power must be very restricted. In Noctuid moths, extensively studied and beautifully illustrated by Eggers, there are two drums in each thoracic organ. A horizontal section shows the cavity to be roughly semicircular, the outer end closed by the true tympanum, to the inner surface of which is attached the tympanal nerve with two scolopales. The inner end of the cavity is closed by a secondary tympanum, regarded by Eggers as a resonator and unprovided with any nerve supply.

Nerve-endings of the scolopale type are found in many insects and in various positions without any accompanying tympanum, and there is no satisfactory evidence that they are auditory in function. They occur in the halteres of Diptera, in the legs of Ants, in an antennal structure known as the organ of Johnston, and in segmental series in many larvae, notably those of Cerambycid beetles.

As to the evidence of auditory powers in insects, Baier's experiments with Field Crickets and other Orthoptera are of considerable interest. In order to

eliminate factors of scent and sight, he connected, by telephone, cages containing males and females respectively. The females responded to the sounds made by the males, by orientating themselves towards, and approaching the receiver. Direct vibrations were eliminated by careful insulation of the cages, and in a subsequent experiment by putting the insects in receptacles carried by balanced balloons. Females whose tympana had been excised failed to respond, as did those which had been locally anaesthetised with ethyl-chloride. Phonographic records of the male notes have a similar effect. Eggers experimented with moths and found that they responded to sounds, by movements of the wings or by flying, but failed to give any response when the tympanum was destroyed. Of the functions of chordotonal organs unprovided with tympana we know even less. Fielde and Parker found that ants gave no reaction to sounds ranging from 27,000 to 60,000 vibrations per second. They reacted to vibrations reaching them through wood, glass, sponge, or nest earth, and such reaction was not dependent on the antennae, head, abdomen, or any one pair of legs. Generally their behaviour could as well be ascribed to touch as to hearing.

On the other hand, Baier found that *Myrmica rubida* responded to high staccato notes from a violin, the formicarium being suspended from the ceiling. The ants ran violently about and hid themselves. The same author showed that some Ephemerids and Coleoptera were sensitive to sounds.

Eggers favours a rhythmic function for the chordotonal organs, pointing out that most of the movements of insects result in rhythms, and there must be organs for controlling and regulating them. Unless chordotonal organs or their equivalent can be found in other animals I confess to some difficulty in perceiving their special necessity in insects. Larvae of *V. antiopa* were shown by Minnich to react to sound, of pitches from 32 to 1024, but he also found that the reaction was due to the tactile sense of certain hairs on the anterior part of the body. So far as we know at present there seems little evidence that insects, other than some Orthoptera and Hemiptera, can hear in any sense comparable with that faculty in vertebrates. Nothing approaching the delicate and discriminative sense which we associate with hearing can be attributed to the most elaborate of such organs in insects. The human ear possesses some 10,000 nerve-rods, 15,000 hair cells, and about 24,000 basilar membrane fibres. It can distinguish differences of less than one vibration per second between 32 and 2048. The nerve supply to the tympanal organs of insects does not warrant any comparison with vertebrate ears.

As we pass from the consideration of the sense of sight, through those of touch and hearing to the remaining senses, the difficulty of locating them is progressively increased. In insects the olfactory sense is probably more highly specialised than any other, nevertheless not only is that sense difficult to define, but it seems in many species to be combined with touch and taste. Distributed over the body of an insect are sensillae of many forms. Several different types occur together in the antennae and it is manifestly impossible to devise experiments which will inhibit the action of one form without interfering with that of others. Of the existence of an olfactory sense there can be no doubt whatever. So far as we are able to compare the reactions of insects with those of other animals, scents of various kinds play a rôle in their economy, the delicacy and importance of which transcend anything in our own experience. Apart from their appreciation of odours

associated with their habits of feeding and oviposition, many of them produce scents as secretions of specialised glands and complex distributive mechanisms. I need not dwell on the phenomenon of assembling, well known to all Entomologists. That the directive agent is a scent diffused by the female seems to be generally admitted, since a receptacle which has recently contained one, proves as attractive as the female herself. Kellogg's remarkable experiments with silk-worm moths showed that the seat of the secretion is in the terminal segments of the abdomen, and that these segments, when amputated, are just as attractive as the whole moth, whilst the mutilated female ceases to have any effect. I have prepared sections from the females of *Ocneria dispar* and *Saturnia pyri*, and can find no special glands in this position. The volatile substance, whatever its nature, must be a secretion of the hypoderm cells, which in this region are much enlarged. Not only must the scent be specific but its perception by the male must be specialised, since the presence of other odours in the neighbourhood does not confuse or inhibit the male reaction. Curiously enough these directive odours are rarely if ever perceptible to our senses. It might naturally be supposed that they would be by far the most important for the continuance of the species, but judging by the widespread occurrence and great complexity of organs peculiar to the male, and apparently having for their function the production of what may be termed aphrodisiac perfumes, the male scent organs would seem to be even more important than those of the female. I need not devote any time to the discussion of male scent organs. Many of their forms in several orders of insects have been described in our Transactions in recent years. Though not sense-organs I refer to them here since their existence is additional evidence of the existence of an olfactory sense. It is an interesting fact that whilst the attractive and directive odours of the female are usually, if not always, imperceptible to our senses, the perfumes produced by male insects are frequently perceptible and almost invariably agreeable. A well-known example is that given off by the scent scales of *Pieris napi*, which resembles that of lemon verbena.

Amongst the most conclusive experiments on the olfactory sense are those of Von Frisch, who trained bees to find a sugar solution in a porcelain box scented with an essential oil having a flowery odour. Three similar but empty and unscented boxes were provided. The bees soon found the sugar box and returned to it with precision, in whatever position it was placed relatively to the other three. Amputation of the four terminal segments of the antennae inhibited the faculty altogether, and the bees then entered the empty boxes as often as that containing the sugar. That the inhibition was not the result of shock was ingeniously proved by putting the sugar in a blue box whilst the empty ones were coloured yellow. The antennaless bees soon learnt to select the blue box, thus showing that they could make use of their colour sense when the olfactory power had been destroyed.

So far as concerns the bee, the olfactory sense is evidently in the last four segments of the antenna. Other experiments have shown, however, that though the antennae are usually the principal seat of this sense, it is not entirely confined to these organs, and Abbott has found that certain carrion beetles could discover decaying meat, buried in sand, after their antennae and wings had been removed, and their leg bases covered with shellac.

If, as we know, our own senses of smell and taste are sometimes liable to be confused, what we call flavours being mainly perfumes, it is even more difficult to separate in insects those senses which most nearly represent olfactory and gustatory powers. It is easy to demonstrate that a butterfly can taste, in the sense of discriminating between substances on which it may be feeding. It will contentedly suck up a solution of sugar, but if a drop of some alien substance such as methylene blue, or picric acid, be added it will at once withdraw its proboscis. We may say that it likes sugar, and dislikes methylene blue. I am not prepared to say that we are wrong in using such terms, though we cannot know whether the insect has conscious preferences associated with taste as we understand it. If, however, we find that it can distinguish between substances merely by touching them with its *feet*, we realise that chemo-tactile is a more appropriate term for a sense which has no exact parallel in our experience. This remarkable tarsal sensitivity has been demonstrated by Minnich and provides an interesting contribution to our knowledge of insect senses. It would take too long to describe in detail the experimental methods used, but certain butterflies were shown to have the power, through tarsal contact, of detecting and distinguishing between such substances as apple-juice, quinine sulphate, hydrochloric acid, sodium chloride, and distilled water. Not only does the insect respond, by extension of the proboscis, to tarsal contact with various fluids, but after long periods of abstention it shows a sensitiveness to sugar solutions some 256 times more delicate than that of the human tongue. Certain Muscid flies were also used for experiment with similar results. I have for some time been investigating the histology of the chemo-receptive sensillae of the tarsi and hope shortly to be able to give some account of them. Meanwhile we are justified in asserting that insects possess a distance chemical sensitivity comparable with the olfactory sense of other animals, and that they also have a chemo-tactile sense, which though not always associated with the mouth-parts can be reasonably termed a sense of taste. Though probably extremely specialised, both these faculties may be associated with a sensitivity immensely greater than we ourselves possess. Having established the existence of such senses it is a much more difficult task to assign them to their appropriate sensillae. Though sense-cells of various forms are concentrated in immense numbers on the antennae, they are by no means confined to those complex organs, and may be found in almost every position all over the body. Numerous attempts have been made to classify the forms of sense-cells, but they are not always clearly differentiated and many intermediates occur. The following classification is based on that of Snodgrass. The supposed function of each type is only suggestive and not fully established by experiment.

I. Trichoid.

1. Trichoid proper. Setiform, but varying in length, thickness and density of the hair walls.

   a. Hair long and stiff. Nerve reaching only to base. (Tactile.)

   b. Hair short and thin-walled. Nerve often reaching apex. (Chemo-receptive.)

2. Squamiform.

   Resembling a scale set in the usual scale socket, but supplied with a nerve. (Tactile.)

3. Basiconic.

Resembling pegs or cones.

a. Pegs thick-walled and innervated by a single nerve. (Tactile.)

b. Pegs thin-walled and innervated by a group of sense cells. (Chemo-receptive.)

4. Coeloconic.

Resembling Basiconic, but the pegs are sunk in cavities of the cuticle.

a. Thick-walled, with a single sense cell. (Function doubtful but evidently not Tactile.)

b. Thin-walled and with multiple nerve-cells. (Chemo-receptive.)

5. Ampullaceous.

A development of the Coeloconic in which the cuticular cavity is much deeper and more flask-like, or may even be a long tube. (Chemo-receptive.)

II. Campaniform.

Variable in shape, but having, externally, the form of a thin-walled dome or bell, or derived from such forms and having one sense-cell. (Function doubtful, probably Tactile.)

III. Placoid.

This has chitinous plates overlying large pores or cavities in the cuticle. (Often called " pore-plates.") Innervated by a group of sense-cells. (Chemo-receptive.)

The chordotonal organs have already been dealt with and are not included in the above classification. The fact that there are so many different types of sense-organs for which we can suggest only two functions shows how very little we really know about insect senses and how much remains to be done by intelligent experiment. The Campaniform organs are the " Olfactory Pores " of McIndoo, who has described their distribution in all the principal orders of insects. Their olfactory function has not, however, been completely demonstrated, and, as Snodgrass has pointed out, organs presumed to be chemo-receptive are usually innervated by multiple nerve-cells. The Placoid type of sensilla seems more definitely associated with the sense of smell. In *Dytiscus* extremely small Placoid organs are found on the antennae to the number of nearly 5000. In the honey bee these organs are very numerous on the antennae and vary in a significant way according to the sex, there being some 30,000 in the male, 6000 in the worker, and 2000 to 3000 in the female. They are the principal form of organ in the terminal segments of the antennae and, as Frisch has shown, the removal of these segments inhibits its response to odours. I am not aware of any notable experiments on the olfactory sense of the cockchafer, but in this insect the antennal organs are mainly of the Coeloconic type and there are said to be some 39,000 in the male and 35,000 in the female.

We have no time to consider organs for which a function cannot even be suggested, such as Johnston's organ, found in the antennae of most insects, Jordan's organ, or the Chaetosema, on the head of Lepidoptera, Graber's organ in the larvae of Tabanid flies, and other interesting structures.

From what I have already said we see that insects possess faculties which may in a limited fashion be compared with those of the higher animals. They are

sensitive to waves of light, sound, and heat, and to chemical stimuli of the nature of tastes and odours. In some instances their power of detecting volatile substances seems far to transcend anything of the kind found in other orders, though they probably respond to a very limited range of such stimuli. The least developed sense would seem to be that of hearing, since organs of sufficient complexity are found in but a few species, and, as might be expected, principally in those insects which are themselves capable of sound production.

The tactile sense is so highly developed and widely distributed that there is some difficulty in distinguishing between true hearing and a mere tactile sense of aerial vibrations. Taste, limited in ourselves to about four principal sensations, may be equally limited in insects, though other parts of the body than those associated with nutrition may be directly involved. Sight may be very efficient at close quarters, and an eye constructed on the same plan as that of a vertebrate would probably serve no better, even if it were not, on account of its small size, actually less efficient.

Insects seem but little less well equipped than other animals within the limitations of their always specialised requirements. Ants can recognise each other and distinguish members of a rival colony. They can even communicate in some way, and induce others to join them in some apparently purposeful action. But of the psychology of creatures so remote from ourselves we can hope to learn little. We have discussed their senses, we cannot estimate their sense. It has been widely held that every action which is now instinctive must once have had its origin in intelligent departure from previous behaviour. It seems, however, equally possible that what has now become a useful instinct may have originally been a departure from previous conduct, due to a favourable variation in nervous reflexes, inherited and then, if we may use the term, encouraged, by natural selection.

At the present time it seems the fashion to deny to every animal except ourselves any power of independent action. One lecturer at the last meeting of the British Association seemed to maintain that even dogs and cats are totally devoid of the least glimmer of what we term intelligence, and that all their actions may be ascribed to unconscious reflexes. We might discuss the matter at very great length without coming to any definite conclusion, the more so since we lack clear definitions of the very words and thoughts we must perforce employ. We can only define the word " consciousness " by " awareness," and, as Snodgrass observes in his essay " On the Mind of an Insect," " to define a thing by its synonyms is only to shift from one foot to the other, but it is the best that can be done, since no one knows anything at all about the true nature of consciousness, and if one shoe fits and the other pinches, it is better to stand in the easy one."

I commend that very interesting essay to those who wish to pursue the matter further, though it contains one paragraph that seems open to argument. The author denies the possibility of the existence in insects of any sense unknown to ourselves, on the ground that in spite of the discoveries of the physicists there is no known force in nature except radio-activity that we have not long known by means of our sense-organs. This may hold good for the nature of the force, but does not apply to its range. Already we know that insects are sensitive to light rays that we cannot see, to chemical stimuli that we can neither taste nor smell, and probably to sounds that we cannot hear. At the risk of treading on the forbidden ground of

anthropomorphic comparison I feel justified in quoting Lord Avebury's words, which, though written nearly a quarter of a century ago, seem still to be worthy of our attention.

"Sound is the sensation produced on us when the vibrations of the air strike on the drum of our ear. When they are few the sound is deep; as they increase in number, it becomes shriller and shriller; but when they reach 40,000 in a second, they cease to be audible. Light is the effect produced on us when waves of light strike on the eye. When 400 billions of vibrations of ether strike the retina in a second, they produce red, and as the number increases the colour passes into orange, then yellow, green, blue and violet. But between 40,000 vibrations in a second and 400 billions we have no organ of sense capable of receiving the impression. Yet between these limits any number of sensations may exist. We have five senses, and sometimes fancy that no others are possible. But it is obvious that we cannot measure the infinite by our own narrow limitations.

"Moreover, looking at the question from the other side, we find in animals complex organs of sense, richly supplied with nerves, but the function of which we are as yet powerless to explain. There may be fifty other senses as different from ours as sound is from sight; and even within the boundaries of our own senses there may be endless sounds which we cannot hear, and colours as different as red from green, of which we have no conception. These and a thousand other questions remain for solution. The familiar world which surrounds us may be a totally different place for other animals. To them it may be full of music which we cannot hear, of colour which we cannot see, of sensations which we cannot conceive. To place stuffed birds and beasts in glass cases, to arrange insects in cabinets, and dried plants in drawers is merely the drudgery of preliminary study; to watch their habits, to understand their relations to one another, to study their instincts and intelligence, to ascertain their adaptations and their relations to the forces of nature, to realise what the world appears to them; these constitute, as it seems to me at least, the true interest of natural history, and may even give us the clue to senses and perceptions of which at present we have no conception."

To-night marks the close of my tenure of the office with which, two years ago, you honoured me. I regret that in recent months my attendance has not been so regular as I could have wished. Many of you know the cause, and I would express my heartfelt thanks for the sympathy that has been so freely expressed. We are approaching the completion of our hundredth year. I am sure you feel with me that it is a fitting climax to a century of continual progress, that our meetings and celebrations during the coming year are to be presided over by the most distinguished Entomologist of our time, of whom it may justly be said that in thus honouring him we do but honour ourselves.

I would take this opportunity to record my deep appreciation of the continual help and kindness I have received from all the Officers, and for the unfailing support and good-fellowship of the members of the Council. We are indeed a happy family, and there can be no misgivings as to the future of a Society in which all co-operate so well for the furtherance of our aims and the high standard of our work.

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OF THE

PROCEEDINGS OF THE ENTOMOLOGICAL SOCIETY OF LONDON

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ERRATUM.

P. 29, line 42, *for Centhorhynchidius* read *Ceuthorrhynchidius*.

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THE ENTOMOLOGICAL SOCIETY OF LONDON

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MEETINGS

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41, QUEEN'S GATE, S.W. 7

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The Chair will be taken at Eight o'clock.

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